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The American Journal of Roentgenology

Edited by P. M. Hickey, M. D.
Associate Editor, F. C. Zapffe, M. D.

VOL. II December 1914 No. 2

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THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, P. M. Hickey, M. D., Detroit
Associate Editor, F. C. Zapffe, M. D., Chicago

VOL. II DECEMBER, 1914 No. 2

PRESIDENT'S ADDRESS

Opening the Fifteenth Annual Meeting of the American Roentgen Ray Society, Cleveland, September 9, 1914

By SIDNEY LANGE, M. D., Cincinnati, Ohio

This morning marks the inception of the fifteenth annual session of The American Roentgen Ray Society. In opening this meeting I am stirred by mingled feelings of pride and humility. I am proud of the present status of the American Roentgen Ray Society. I am proud of the past and present achievements of its individual members and of the unparalleled development of the art of Roentgenology during the brief lifetime of this Society and especially during the past year. I am humbled however by the keen appreciation of the responsibility which the position of presiding officer of this learned body imposes. I am sensitive to the great honor that you have conferred upon me and I desire at this moment to voice my gratitude. I desire further to thank the various members for their interest and co-operation in matters having to do with the success of this meeting.

In editing a scientific program for a meeting such as this, one is impressed by the breadth of our so-called specialty. What promised at the outset fifteen years ago to be the narrowest of specialties has developed into the broadest. The Roentgenologist must start out as does any efficient doctor of medicine thoroughly grounded in anatomy, physiology and chemistry, in general and special pathology, in general and special clinical and physical symptomology and in every phase of therapy, medical and surgical. In addition to these requirements he must in order to fully develop his art be trained in the physics of radiant energy, to wit: Light, electricity and radio-activity. He must be master of the theory and practice of photography. He must acquire a knowledge of the so-called X-ray anatomy and physiology. He should be a good dermatologist. He must have a knowledge of dental pathology and therapy. He must have executive ability in order to plan, organize and develop a Roentgen laboratory. He should possess mechanical genius in order to devise and perfect the various features of his apparatus and laboratory appliances. He must take part in the war on malignant disease and in the prophylaxis of tuberculosis. He should become as a result of cumulative experience a safe prognostician as well as diagnostician and he should develop into a careful medico-legal adviser. The not far distant future may develop the necessity for more intensive specialization by the sub-division of the general field of Roentgenology into smaller branches. In view of the ever extending range of Roentgenology it becomes impossible to adequately cover the entire subject in the program of any one annual meeting. The accuracy

of this assertion was firmly impressed upon me in providing the present program. It might seem advisable and necessary for the coherence of future programs to limit the papers to the discussion of two or three subjects which might be selected at the meetings preceding. Such a plan would make for thoroughness and intensive analysis of our work.

The past year has been a very prolific one for Roentgenology. Through a combination of events Roentgen therapy has been greatly enhanced. Now it promises to take its true and deserved position among the medical sciences. As result of cumulative experience research methods have been devised to deliver X-radiations to the *deeper* parts of the body in safe yet efficient quantity. The principle of filtration which was first brought out by one of our members has been so amplified as to remove or lessen many of the dangers incident to the administration of therapeutic X-light. Improvements in generating apparatus promise to supply a high tension current of proper attributes for successful therapy. The Crooke's tube has undergone many transformations which adapt it more and more to the needs of Roentgen therapy. Clinical reports as recorded in the literature of the past year have by the force of their own volume proven and established many points which have heretofore been subjudice.

It is with much pride that we mention the production of the hot cathode tube as a priceless contribution from an American to the art of Roentgenology. Since we may now hope for the production of homogeneous X-light whose quality and quantity may be varied at will, so may we hope for the realization of the results of homogeneous irradiation which have been so long and so earnestly striven for by many continental roentgenologists. While many undesirable and disturbing elements have been eliminated from the bundle of therapeutic X-light one great problem which concerns its method of production still awaits solution. This problem is one which has been uppermost in the minds of physicists since the beginning of physical science. It is the production of light without heat. This great hindrance to Roentgen therapy has however been minimized by the introduction of ingenious methods of heat dissipation. Much further relief from the annoying development of heat incident to the generation of X-light is an imperative need however, and it is to be hoped that during the ensuing year much progress will be recorded along this line.

Very gratifying is the altered attitude of the internist and surgeon toward Roentgen therapy. The esteem which many surgeons frankly evidence for X-Ray therapy and the intimate co-operation between many surgeons and roentgenologists bespeak the great advance made by X-ray therapy during the past year. The achievements of several progressive German clinics is largely responsible for this increase of confidence in X-ray therapy.

It is with much interest that the roentgenologist notes the more extensive use and the brilliant results obtained by the larger quantities of radium and its allies. The more intensive application of radioactive substances to therapeutic ends has prepared the way and inspired the evolution of a new species of X-rays of ever increasing hardness and has given us a standard of penetration toward which to strive. There is still, however, a large hiatus in our knowledge as to the exact character of ray best suited to produce a specific result in a specific tissue and it is to be hoped that the ensuing year will at least in measure fill in the hiatus. Nature has been kind indeed to the Roentgen therapeutist. She has endowed the various cell groups in the human body with the unique attribute of reacting differently or at least reacting in widely varying degree to X-ray impingement. Holzknecht says that every living cell which has absorbed X-rays will suffer a chemical change which may produce no appreciable effect or may result in stimulation, irritation, degeneration or necrosis. Since Holzknecht's dictum has never been disproven it remains simply for the Roentgen

therapeutist to deliver to a given group of cells an amount of X-rays of a specific kind sufficient to produce the desired degree of reaction. This is the goal toward which the future points. And while its realization may seem Utopian and impossible we should remember that the X-ray admits of a more comprehensive application in the treatment of disease than any one agent in our therapeutic armamentarium.

Of great interest to the roentgenologist is the work done during the past year by a foreign physicist which further confirms our conception of the nature of X-radiations and their analogy to sunlight. It has been accepted and we have taught our students that the X-ray could not be refracted or diffracted. But the inability to diffract or disperse the X-ray was due to the inability to artificially prepare a diffraction grating whose lines were sufficiently close to interfere with the very short wave of X-light. It was found however that a proper diffraction grating existed in nature in the form of a certain quartz whose molecular system presented fourfold symmetry and whose intra-molecular spaces were sufficiently minute. In this way the X-ray had been dispersed and its wave length computed.

In the measurement of the quantity of X-radiation delivered, the past year has offered nothing new and we are still constrained to use our so-called physiologic meters. In the estimation of the quality or penetrating power of the ray the work of Christen promises to standardize and correlate all the penetration gauges in present use and to give us a real standard of penetration against which all other scales may be calibrated. Just as 1 cubic centimeter of distilled water is the standard 1 gram weight, in the same way the absorptive power of a cubic centimeter of distilled water has been suggested as the unit of absorption. Penetration is then expressed in terms of centimeters or fractions of centimeters of distilled water necessary to absorb one-half of a given bundle of X-light. Instead of distilled water a synthetic quartz called bakelit which has the same co-efficient of absorption as distilled water, may be used. Such a standard would eliminate much of the confusion caused by referring to different scales calibrated arbitrarily. Such a distilled water scale would be free from all sources of error and would be accurate both for filtered and unfiltered rays.

The European War has severed our intimate communication with our English, French and German colleagues. It has hindered intercourse through medical literature and has in this as well as in other ways deprived us of an inexhaustible source of inspiration for future endeavor and emulation. The fact that English, French and German clinics are greatly embarrassed in their scientific work during this crisis throws for the present the entire burden of progress and discovery upon the American roentgenologists and it is certain that they will not be found wanting.

The foreign guests who had promised to take part in this meeting are unable to attend and it is with much disappointment that I announce the fact. The last communication that I received from Dessauer was written by him July 29 and all unawares of the impending crisis he promised to send the name of his steamer shortly and the date of his arrival in New York. A letter from Barclay two weeks ago stated that he was occupied in organizing a Red Cross Corps.

DEEP ROENTGEN-THERAPY AND ITS APPLICATION IN THE TREATMENT OF MALIGNANT GROWTHS

BY SAMUEL STERN, M. D.

Radiotherapist to Mt. Sinai Hospital and Chief of the Radiotherapy Department, Mt. Sinai Hospital Dispensary

The technique of the administration of Roentgen-Therapy in malignancy, especially in deep-seated lesions, has recently undergone such a radical modification, that one may be permitted to speak of "Deep Roentgen-Therapy" as one of the newer branches of Roentgenology.

The chief modifications are based upon the following:

1. The use of aluminum filters.
2. Cross fire administration.
3. Massive doses.
4. The use of rays of a certain degree of penetration.

Taken separately, there is nothing radically new in any of the items mentioned, but carried out collectively, following a carefully worked out formula, it marks a radical departure in Roentgen-Therapy.

1. ALUMINUM FILTERS.

In 1903[1] Perthes drew attention to the fact that it was possible to increase the penetration of the X-rays emitted from a tube, by permitting them to pass through an Aluminum filter.

This increase in penetration is due to the fact that the soft rays are filtered out by the Aluminum, thereby materially increasing the penetrability of the remaining hard rays.

In 1904[2] after extensive experiments he showed that 1 mm. of Aluminum absorbs approximately the same amount of rays as is absorbed by 1 cm. of animal tissue (except lung tissue) or by 1 cm. of water.

These experiments probably laid the earliest foundation to deep therapy as applied today.

Improvements in technique gradually developed after this, but it was not until the valuable and exhaustive work done by Gauss and Lembcke[3] at the Freiburg school (published in 1912) solving the question of the thickness of filter to be used, dosage, proper degree of hardness of ray, etc., that the administration of "deep Roentgen-therapy" received its most radical modifications

The thickness of the Aluminum filter that they found best adapted to treatment in deep seated lesions, is 3 mm. In lesions situated nearer the surface, 1 or 2 mm. may suffice.

In addition, to avoid the secondary rays produced in the filter, it is advisable to use 3 or 4 layers of Satrap papier (thick photographic paper) and a flat loofah sponge filter, placed over the area to be treated.

2. CROSS FIRE ADMINISTRATION.

This simply means attacking the lesion from all directions.

It enables us to give a larger amount of ray, by giving more skin surface to work on, and it appears to have a decidedly more powerful effect upon the lesions treated.

The usual method of procedure is to divide all sides of the area to be treated into small fields of 25 to 30 sq. cm. and to treat each field in rotation.

Although some men use two or even 3 tubes at the same time—Warnekros[4] describes a technique that he uses occasionally in the treatment of Carcinoma of the Uterus, where he places two tubes over the abdomen and one into the vagina all working simultaneously.

On a recent visit to Berlin, I saw him use the double tube method, but cannot say that I was much impressed with the advantage of it. His main object to save time is defeated by the fact that the current cannot

be turned on until both tubes are placed in position, and the vacuum of both tubes must be identical to have them working right. To regulate this takes time, so that whatever is saved by the combined exposure, is lost by the preliminaries.

3. Massive Doses.

Up to a comparatively short time ago, the usual routine in X-ray therapy was to administer a fractional dose, two or three times a week, until the patient received a certain amount, or until the first sign of a dermatitis developed.

This was rather an unsatisfactory method as it was very difficult to estimate the amount of ray administered, and often the dermatitis became more severe than was anticipated, or the results were not satisfactory on account of the insufficient quantity of the ray given.

All this has been obviated by giving one carefully measured massive dose up to the degree of toleration, and then discontinuing treatment until the effect of this dose had worn off.

The amount that can safely be administered in one treatment, has increased a great deal with the use of the Aluminum filters.

So we find that by using a 3 mm. Aluminum filter, and a ray of high penetration, an amount equal to 3 or 4, or more erythema doses (measured without a filter) can safely be administered without any danger of producing even a first degree dermatitis.

The amount generally administered at one sitting, is about 15 to 20 X measured under 13 mm. Aluminum.

This can be safely given once every 3 weeks, without any danger whatever.

The method I saw them use in abdominal malignant growths, at Kroenig's clinic in Freiburg was, to dissect the skin over the abdomen, stitch back the flaps, and pour in rays "ad libitum" over the dissected area.

The amount that could be administered this way without producing any dermatitis is almost incredible.

I saw them give a patient with a Uterine Carcinoma, daily treatments for weeks, each treatment amounting to what would ordinarily measure up to at least 10 erythema doses, without any visible signs of injury.

We also find that certain tissues possess a wonderful tolerance for almost any amount of X-rays without showing any injury.

Thus, for instance, the mucous membrane of the vagina will tolerate any amount of hard filtered rays.

By carefully protecting the outside area, one can give through the vagina daily treatments, lasting for hours each time, continued indefinitely for weeks, without producing even the slightest dermatitis.

In fact the only thing that seems to determine the amount of rays that can be given this way, is the time at the operator's disposal, and the length of time the patient can stand the discomfort of the position.

Warnekros[5] at Bumm's clinic in Berlin claims that by the use of a transformer manufactured by the Veifa-Werke, in connection with a water spray tube, so called "Maximum tube" which gives a very large percentage of hard rays, he is enabled to increase greatly the amount of his dosage, over any skin area, without producing any injurious effect.

He administers over each area treated in eight succeeding days, an amount equal to about 350 X measured under 3 mm. of Aluminum. At the end of this time a slight dermatitis develops which generally disappears in about one week, without giving the patient the slightest discomfort.

I saw him use this tube and apparatus and was much impressed by the large quantity of ray that it produces.

In quality it did not seem to differ from the rays we got from the "Muller Rapid" or the "Penetrans tube" but evidently there must be a difference because no skin would tolerate the dosage from these tubes that he advocates to be given with the "Maximum tube."

I experimented with an American-made spray tube, built on the same principle as the "Maximum tube," but found that it did not

possess any advantage over the "Penetrans tube" whatever.

I might say a word about the method of measuring the dosage in deep therapy:

We have no accurate means of measuring the dosage at present. All our methods are merely comparative. The one mostly used is by means of Kienbock strips placed upon the skin. We know that 10 X without a filter constitutes an erythema dose, and this has been our standard.

But we find that by using 1, 2 or 3 mm. Aluminum filters we can give 20, 30, 40 or even more X without producing an Erythema, so that if 10 X does not mean an Erythema dose and 20 X does not mean two Erythema doses, then X has no real significance.

The ordinary Kienbock scale and strips as manufactured, cannot measure above 10 X.

To obviate this, a scale has been devised by Gauss to measure higher dosages up to 25 X. This scale can be used only when the ray is measured under 13 mm. Aluminum and the tube used is pumped to 9½ to 10 Wehnelt. With a lower tube the amount registered would be too small and with a higher tube too great.

In discussing this question with Kienbock I found that he disclaims all responsibility for the scale and considers it not very accurate.

Nevertheless it is probably at present the best method we have, although merely comparative, and answers the purpose of getting some idea as to the amount of ray given.

The solution of the problem will be, to determine the amount of ray necessary to produce an Erythema with a 1, 2 and 3 mm. filter, and to construct scales on these standards.

4. The Use of Rays of a Certain Degree of Penetration.

The degree of penetration that has been found probably most advantageous in deep therapy is from 8½ to 9 Bauer (12¾ to 13½ Wehnelt).

Anything below this does not possess a sufficient quantity of hard rays to produce the best effects.

There seems to be a limit to the hardness of the ray that can be used to advantage in therapy.

I think this is due to the fact that probably the most powerful therapeutic effects are produced by the rays which are absorbed by the tissues we aim to effect.

So that extremely hard rays which penetrate the tissues very rapidly, and are absorbed by them but to a slight degree, will produce very little change in the tissues through which they travel.

This is purely an hypothesis, and probably is not endorsed by some of our best Roentgenologists, but nevertheless I have found in my experience, that extremely hard rays which measure above the Bauer scale do not appear to possess much therapeutic value.

Although I have seen Kienbock work with tubes, which he calls over-hardened tubes, which are so hard that sparks are continually playing around the tube and which cannot give more than 2 or 2½ Ma. even with the strongest current passed through them.

As to the results accomplished with "deep therapy" in the treatment of Malignant Growths, there is no question that they have been decidedly more satisfactory since we have adopted the technique which I previously described.

Although, despite the advances we have made in this subject, it still holds good that no operable cases of deep seated Malignant Growths should be treated with X-ray, except where patients refuse to be operated upon.

The treatment is still reserved for inoperable cases, for recurrences, and for prophylactic treatments following operation.

The scope of this paper does not permit me to go into any detailed history of the cases I have treated.

As a matter of fact I do not think that detailed histories of cases cured, improved, etc., have any other than statistical value, for there seems to be some individual, in-

tangible something which practically puts each case into a class by itself.

The result of fourteen years' work with Roentgen-therapy and the treatment of hundreds of cases of deep seated malignant growths, treated in hospital and private practice force me to the conclusion, that there is some at present unrecognizable difference in apparently identical cases, which determines the degree to which they will respond to X-ray treatment.

This difference is irrespective of microscopical findings, tissues involved, condition of patient, etc.—although it probably has some bearing upon the degree of malignancy that we cannot recognize at present. I am sure that most of you have come to similar conclusions. I have seen a case of recurrent Adeno-carcinoma of the Uterus entirely disappear under treatment, where the next apparently identical case showed very little improvement under the same treatment.

I have seen a case of Carcinoma, involving the left nares and antrum entirely disappear and remain well up to date (4½ years) where other similar cases did not respond.

A case of Epithelioma of the tongue with glandular involvement, is perfectly well today, almost 5 years after treatment, where other apparently identical conditions showed practically no response whatever.

One might go on and cite these cases indefinitely.

At any rate, while we sometimes get extremely satisfactory results in the treatment of deep seated malignant growths, we are still in no position to make definite promises at the beginning of treatment, as to the probable termination of any case.

The fact that we occasionally get brilliant results in the form of cures, very often improvement in symptoms, in the alleviation of pain and prolongation of life,—I think is sufficient to justify our demand that all cases of inoperable and recurrent malignant growths should be given the benefit of this chance, before they are given up as absolutely hopeless.

Especially until the advances in medicine have produced something that offers more hope.

COMBINED TREATMENT

Roentgen-therapy in Malignancy is very frequently combined with other allied methods of treatment, such as Radium, Mesothorium, etc.

This is too wide a field for me to enter upon in this paper, besides it is only a short time ago that I published the results of my observations on this question.[6]

But I might mention a few words in connection with the combination of injections of various Colloidal metals with Roentgen-therapy.

Probably the most important of these is the combination devised by Czerny and Werner at Heidelberg, under the name of "Enzytol."

This is a combination of borate of cholin in connection with Colloidal Selenium and Vanadium. It is given in the form of daily intravenous injections and is always given in combination with Roentgen ray treatments. It makes the tissues much more susceptible to radioactive treatment, and in addition has the facility of absorbing the rays and carrying them through the circulation to the metastases.

The injections are given as follows: Begin with 2 c. c. of a 10 per cent. solution to 18 c. c. of a physiological saline solution. This is done for 2 or 3 days, when the dose is increased to 3 c. c. to 17 c. c. of saline solution. Three days later it is increased to 4 c. c. to 16 c. c. of saline solution, which is about as strong as it is advisable to be used.

The treatment is continued daily for about 3 weeks or until the patients complain of a great deal of weakness. It is then discontinued for 3 weeks and repeated again. Injections must be given very slowly. During the injections the patients suddenly develop symptoms of congestion, salivation, lacrymation, and nausea, but this only lasts from one-half to one minute. In carcinoma of the bladder the enzytol is injected through a

catheter, 10 c. c. of a 10 per cent. solution to 50 c. c. of saline.

If veins cannot be found for intravenous injections, the solution may be injected into the gluteal muscles. For this purpose they use 4 to 5 c. c. of the 10 per cent. solution undiluted. In prophylactic treatments after operations, they also combine enzytol injections with Roentgen ray.

They think that with the combined method their results are decidedly better, especially in malignant growths involving the digestive tract.

I have been using enzytol for the past few months, but my experience with it is entirely too limited to justify my drawing any conclusions.

PROPHYLACTIC TREATMENT

The post operative X-ray treatment of malignancy, with the object of reducing the chances of recurrences, is developing into one of the most important branches of deep Roentgen-therapy.

During the limited length of time, since it has been carefully and systematically carried out, it has been shown that it unquestionably diminishes the percentage of post operative recurrences.

It should be used in every case, following all operations for malignancy, no matter how radical and thorough the operation was, and how little chance there appears to be of recurrence.

No matter how carefully a surgeon operates, it is impossible for him to know that some small, almost invisible affected gland has not escaped his attention.

It is these small foci which develop and are generally the source of future trouble.

We know the powerful effect the ray has upon glandular tissue, and we can readily understand how a thorough course of raying would help to keep the development of these glands in abeyance.

Prophylactic treatments to be efficient, must be thorough, systematic, and persisted with, for a period of at least 3 years. Perhaps the best routine is to begin treatment about 10 to 14 days after operation.

The first 4 series are given at intervals of 4 weeks, followed by treatments given every 6 weeks during the balance of the first year.

The second year every 8 weeks, and the third year every 3 months.

The area to be irradiated is divided into small fields and each field is given about 15 X of hard, filtered rays, measured under 13 mm. of Aluminum.

In Carcinoma Mammae, we must be sure to include the entire surface, beginning laterally from the outer margin of the sternum to a line drawn with the outer border of the axilla, and longitudinally from the diaphragm up to and including the supra-clavicular space.

Considering that the treatment is not accompanied with any danger whatever, and that the length of time between treatments is so long, that it does not entail much hardship upon the patient, I feel that it is high time the surgeon should be made to realize that his responsibility does not end with the operation and that he has been derelict in his duty in not advising his patients to have the operation followed by a course of prophylactic raying.

They are most assuredly entitled to that additional chance.

Unfortunately the average surgeon is a believer in his knife only and has but little faith in any other method of treatment.

He operates again and again on a patient and will only relinquish them for other methods of treatment when they have reached the final stages of their illness.

This is a grave error; there is no doubt whatever that if these patients were referred to us shortly after operation, we could be in a position to do a great deal more for them.

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POSSIBLE EFFECT OF MORPHIN ON INTESTINAL MOTILITY

By HENRY K. PANCOAST, M. D., Philadelphia

The following brief report is presented because of the unusual gastro-intestinal motility observed during a Roentgen examination and ascribed to the effect of morphin given to the patient by mistake shortly before the examination was made.

The patient was a female aged 21, whose chief complaints and symptoms were chronic and obstinate constipation, evidences of intestinal stasis, and periodic attacks of cramp-like pains in the upper abdomen, frequently requiring morphin. An appendectomy four months before failed to give any relief.

The first Roentgen examination was made six hours after a breakfast of oat meal and bismuth subcarbonate. No additional food was taken in the interval. The Roentgen findings were as shown in Fig. 1. There

FIG. 1

was no residue in the stomach. Most of the opaque material was found collected in the small bowel on the left side, but no portion of the gut showed any distention or sign of obstruction. At first glance with the screen the shadow on the left side was taken for that of the stomach, and then the descending and transverse colons, but palpation showed it to be due to opaque material in the small bowel.

After administering the second meal of two ounces of bismuth in suspension, the stomach under the screen in the erect posture first presented an appearance suggesting a complete "hour glass" contraction, and no opaque material was seen to pass beyond the supposed constriction. Subsequent examination in the prone posture showed the stomach to be very small, with the pyloric extremity contracted, but the bismuth began to pass out through the contracted portion and the pylorus with great rapidity, so that almost the entire contents were emptied in a

FIG. 2

few minutes. No peristalsis was observed. In the lateral and prone postures the duodenum was constantly crowded with bismuth during this time. Fig. 2 shows the roentgenogram made very soon after the second meal and before the greater part of the gastric contents had escaped. The position of the gas collection in the large bowel suggested a redundant sigmoid, which was found later. This displaced the small bowel to a certain extent.

FIG. 3

Fig. 3 shows the roentgenogram made eighteen and one-half hours later. The opaque column had advanced as far as the beginning of the sigmoid. There were no adhesions involving the large bowel as far as the opaque column had advanced. Fig. 4 shows a roentgenogram made after a rectal injection of bismuth, demonstrating the presence of the redundant sigmoid previously suspected.

On searching for a possible cause for at least the lack of motility in the small bowel, it was learned that the patient had an attack of pain during the night previous to the first examination, and was given a hypodermic

FIG. 4

injection of morphin. As no other explanation was forthcoming, this was taken to be the cause of the peculiar phenomena noted, and in order to prove this a control examination was made several days later. Fig. 5 shows the roentgenogram made six hours

FIG. 5

after the bismuth breakfast. Although there was some delay in the last part of the ileum, there was no such lack of motility as was noted at the previous examination. After the second meal the stomach was found to occupy about a normal position for the individual, although slightly ptosed, and showed neither contraction nor hypermotility in emptying.

The anatomic Roentgen findings were confirmed at operation a few days later, when an ileo-sigmoidostomy was performed.

Further Roentgen studies are now being made to determine the effect of morphin and other drugs on gastro-intestinal motility.

3400 Spruce Street.

THE HYDROGEN X-RAY TUBE

By EDWIN W. KELLY

All X-Ray tubes at present may be divided into two general types:

THE GAS TUBE AND THE ELECTRON TUBE.

The development of the Hydrogen tube covers original experimental work with the Electron type also, independently of other workers. Many such tubes were constructed and tested but finally abandoned in favor of the Hydrogen tube whose vacuum may be raised and lowered and operated with heavy currents indefinitely without the limitations and complications of the Electron type.

Before going into a description of the new Hydrogen tube, let us consider the action which accompanies the generation of X-Rays and try to form some physical conception of what takes place within the bulb.

It would be well also to define a few of the familiar terms used in connection with conduction through gases. To quote Adams on Radioactivity—"The four terms: Cathode particle, Beta particle, Corpuscle, Electron, all mean exactly the same thing—A negatively charged particle, known only in motion, carrying the elementary electric charge ($e=4.774 \times 10^{-10}$)."

"The distinction between them arises from the fact that the particles appear under different conditions." "In the first place, the cathode particle is so called because it appears as if it were shot out from the cathode in a vacuum tube when an electric discharge is sent through."

"The Beta particle is emitted by radioactive substances; the corpuscle and electron, which mean exactly the same, are general terms for both of these particles, and they are used when we wish to speak of them in general."

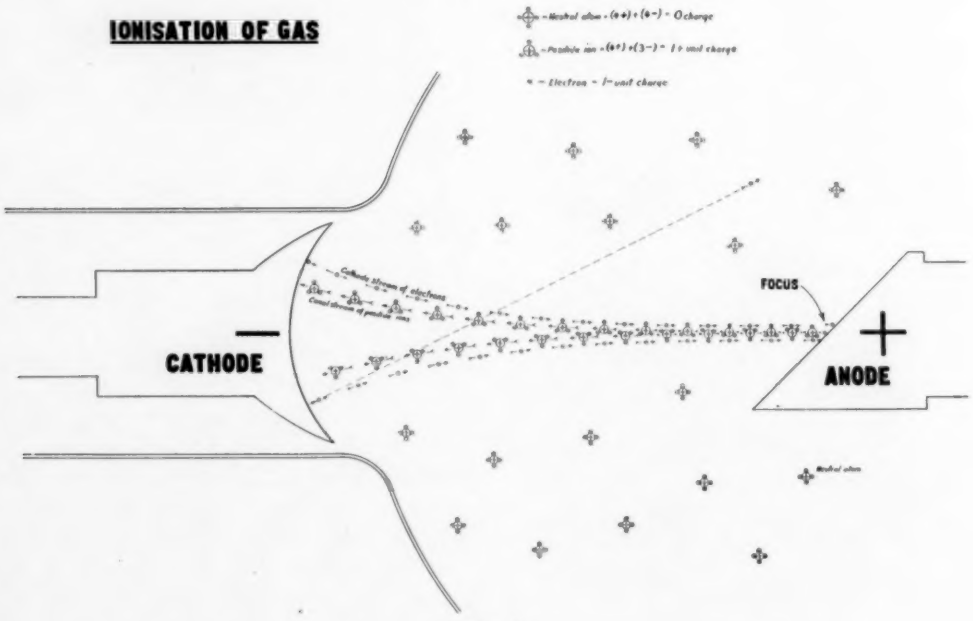


FIG. 1

"Ion—A general term for a charged atom or molecule or a cluster of atoms or molecules." "May be charged either positively or negatively."

To quote Rutherford—"Hence we may conclude that the apparent mass of the Electron is only about 1/1700 of the mass of the Hydrogen atom." "The Electron thus behaves as the smallest body known to science."

In a tube with an absolute vacuum having no gas and no free electrons available, it is generally accepted that no current can be passed through it, however high the voltage applied, even if the terminals are mounted within 1/16″ of each other. What, then, is necessary to establish conduction and what is the most practical way to do it?

At least one thing which is fundamental must be done and that is to supply the Cathode with Electrons, when a current will flow the instant potential of the right polarity is applied to anode and cathode. This flow of electrons from cathode to anode is called the *Cathode Stream.*

In the Electron type they are supplied by an incandescent Cathode.

In the Gas type they are derived from the atoms by ionization. (See Fig. 1.)

To quote Adams—"The leading idea of Thomson's theory is that negatively charged corpuscles—or electrons—are shot out from the cathode; that these corpuscles by their collisions with the neutral molecules of the gas *ionize* them; that is, split them up into positive and negative parts; the positive ions travel towards the negative electrode, the cathode and the negative ions toward the positive electrode, the anode."

Rutherford says—"It is remarkable that, so far, no case has been observed where the carrier of a positive charge has an apparent mass less than that of the hydrogen atom."

We are all familiar with the experiment with a pith ball, which, suspended by a silk thread, and brought into contact with a charged electrode, receives a charge of like polarity and is repelled. Likewise, the electron at the surface of the cathode being negatively charged is repelled at moderate velocity at first and gradually accelerated to a velocity approximating ½ velocity of light as it approaches the anticathode, where by impact at the focus point its motion is arrested, giving rise to X-Rays emanating therefrom. If those corpuscles or cathode particles as we may now call them, which are projected from near the edge of the cathode face, continue in a straight radial line through the center of curvature of the cathode face they would strike the inner wall of the glass bulb. It is a matter of fact, however, that the cathode particles are deflected from their initial straight course and strike the anode target within a very small area called the focus spot. Their trajectory is influenced by the repulsion of other cathode particles likewise charged negatively and by attraction of the anode which is of opposite polarity. By proper shaping of the cathode and spacing from the anode, practically all the corpuscles of the *cathode stream* may be brought to a small focus. In the Gas type of tube there is also a stream of *positively* charged ions known as the *canal stream* which travel from anode to cathode, in the form of a conical shell whose apex is the focus spot, its base being on the face of the cathode: picture the conical shell of water issuing from the spray nozzle of a garden hose. J. J. Thomson, in speaking of the cathode rays, says:

"We should expect there would be a tendency for the rays to attain a maximum at some place intermediate between the center and edge of the cathode." The observations of Campbell Swinton established the existence of such an effect; he found that with concave cathodes, when the pressure of the gas is within certain limits, the cathode rays do not form a solid pencil but are condensed into a hollow conical shell. He proved this by means of the phosphorescence produced by these rays on a carbon plate whose plane was at right angles to the cathode; the phosphorescent patch was a circular ring."

Thus we see there are rapidly moving particles which travel in both directions between

anode and cathode, in the form of two concentric conical shells, whose apices coincide with the focus spot, and their bases lie on the cathode face.

The total amount of gas involved within a seven-inch bulb is exceedingly small, about the volume of a one-sixteenth-inch sphere at atmospheric pressure, a rather small amount of matter to have imposed upon it the duty of transferring three horse power of energy (an exposure of about 40 m. a. at a 4″ vacuum.)

Having formed some idea of the function of the gas, its properties are next in order.

The following may be named as desirable:

1. Ionize quickly—without "lag."
2. Have low dielectric cohesion to ionize at low potential efficiently.
3. Small absorption of cathode rays.
4. Ionize uniformly without intermission.
5. Have low viscosity.
6. Be chemically inert to glass and electrodes.

J. J. Thomson published in his book on "Conduction of Electricity Through Gases," measurements made at pressures somewhat greater than those employed in X-Ray tubes, which indicate that Hydrogen is the best for Nos. 1, 2, 3 and 4 as above mentioned.

To quote—speaking of Carbonic Acid—"It is one in which the 'lag' of the spark is exceedingly pronounced."

He gives rough measurements of spark length at constant pressure as follows:

H 2	15 to 20
N 2	10 to 15
O 2	8 to 10
Co 2	8 to 11

and so on for fifty others, all worse than these four, and comments as follows:

"It will be noticed that the spark lengths are short in vapours of complicated chemical constitution in which the mean free paths are small."

Thus Hydrogen is 4% better than Nitrogen and 84% better than Oxygen.

Reference is made to Kaufmann, who found the following coefficients of absorption of cathode rays:

H 2	730
N 2	5650
Co 2	6830

Hydrogen thus showed less than one-seventh the absorption of nitrogen.

A very interesting observation from the work of Carr and Capstick is quoted as follows: "It is exceedingly difficult to get a continuous discharge through a compound gas. If a circuit containing a telephone is placed in series with the discharge tube, Capstick found that it is almost impossible to get the telephone silent when a compound gas is in the tube; while there is no difficulty whatever in doing so with an elementary gas. The singing of the telephone indicates that the discharge is intermittent."

As to Viscosity, Travers gives the following:

H 2	.000084
Co 2	.000145
N 2	.000167
O 2	.000191

It is almost inconceivable to think of the conical shell of gas between anode and cathode as being the only portion active; while the gas in the rest of the bulb remains idle. A low viscosity would therefore facilitate

FIG. 2

the circulation accompanying ionization. By the above table of viscosity, Hydrogen is 72% better than Carbon Dioxide, about 100% better than Nitrogen and 127% better than Oxygen.

The chemical affinity of Hydrogen for the glass and terminals within the tube is rendered practically nil, by a process of seasoning.

It is interesting to note that "Barkla" has made a very careful examination of the secondary Roentgen rays produced when the primary rays pass through a gas; he has shown that when the primary rays pass through different gases at the same pressure, the intensity of the secondary radiation is proportional to the density of the gas. Hydrogen, therefore, would give the least intensity of secondary rays.

It might, at first thought, be concluded that if there were no gas at all in the tube, such as in the Electron type, there would be less useless rays than with Hydrogen gas, whereas there is actually more diffuse radiation as proven by comparing pin hole radiograms of both types. (See Fig. 2.)

This apparent paradox is probably accounted for as follows: Stray cathode particles are compelled to run the gauntlet of many hydrogen molecules which become ionized by their impact, the corpuscles thus robbed of their energy cannot strike the glass or anode with sufficient velocity to generate much Roentgen radiation. The electron type, having no gas, permits the corpuscles to go unmolested until they strike the glass or anode at high velocity, giving rise to very penetrating rays.

It is interesting to note that the Canal Stream of positively charged particles, the Cathode Stream of negatively charged particles and the X-Rays accompanying the operation of a gas type X-Ray tube have their parallel types of radiation, the Alpha particles, the Beta particles and Gamma rays respectively given off by so many radioactive materials. One theory of the electron type of tube, attractive because of its simplicity, accounts for only the cathode particles and the X-Rays. The general associa-

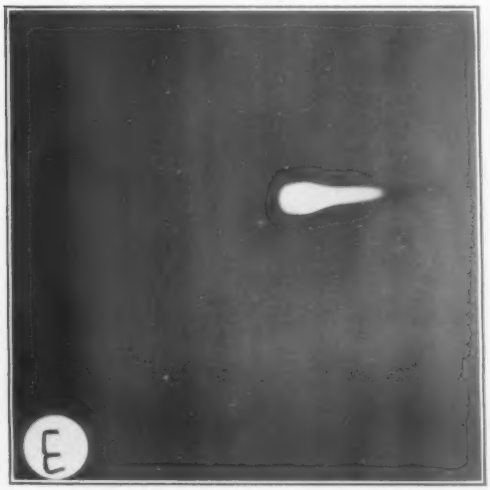


FIG. 2-a

PIN HOLE RADIOGRAPH

Exposure = 5 MA x 90 sec. x 3" parallel spark.

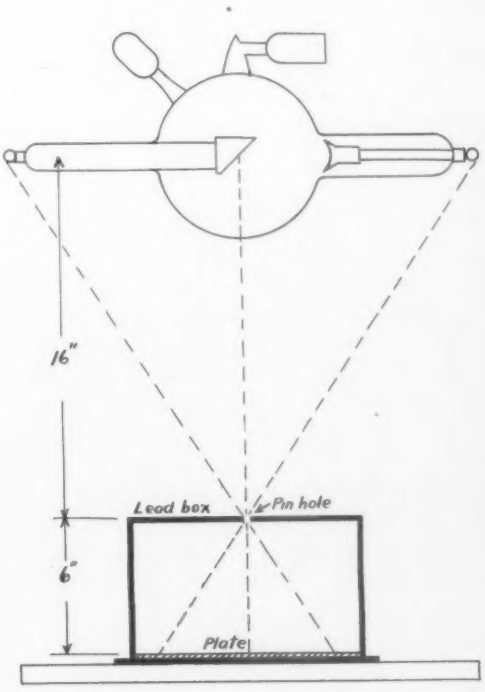


FIG. 2-b

tion of all three radiations suggests the probable existence of a Canal Stream of positively charged particles in the electron type also. This opinion is shared by others, but, as yet, not proven. (Fig. 3.)

that is not clean enough. An additional electrical process is necessary before they are sealed to the glass work and a final refining process is added during the process of pumping. The tube thus treated is freed of all

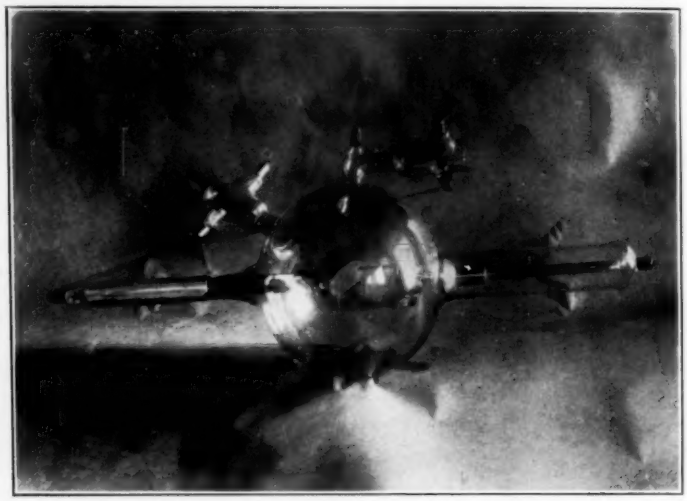


FIG. 3

That which distinguishes the new Hydrogen tube is not so much its radical departure from untried principles as its close relation to them, embodying a number of improvements in details.

The tube is pumped so dry and free of foreign gases that no current will pass with 100,000 volts applied. To accomplish this, it was necessary to develop an elaborate pumping system including several pumps, and embodying new principles incorporated in the latest types of design. The glass is maintained at a high temperature, approaching that at which it softens, in order to free it of all occluded and adherent foreign gases. Likewise the anode which has large quantities of occluded gases imprisoned within its pores, is maintained at a bright red heat until all the foreign gas is given off and the tube admits of little or no current with 100,000 volts applied.

The osmotic tubes of the regulator are made as near chemically pure as possible by the manufacturer, but experience proves that foreign gases even at temperatures above those attained in normal X-Ray work and in all future operations nothing but pure Hydrogen is introduced into the tube.

The vacuum is raised or lowered by taking advantage of the vigorous osmosis of Hydrogen through certain metals, principally palladium.

Professor Nernst, in his book on "Theoretical Chemistry," gives some laws of osmosis which apply to the regulator. He says:

1. "Reference has already been made to the well known phenomenon that substances in solution, when left to themselves, wander from places of higher to those of a lower concentration—"

2. "—palladium foil at high temperatures possesses the property of allowing Hydrogen to pass through easily, but of hindering other gases."

3. "Hydrogen dissolved in—palladium gradually spreads through the whole metal, as has long been known."

4. "—the osmotic pressure is exactly the same as the gas pressure which would be observed if the solvent were removed, and the dissolved substance were left filling the same space in the gaseous state at the same temperature."

5. "—the osmotic pressure is independent of the nature of the solvent, and in general obeys the laws of gases."

Thus we are to regard the Hydrogen as being in solution with palladium the solvent, which "hinders," if not totally obstructs, the passage of air.

Hydrogen, on the other hand, has free access to and from the main bulb by way of the osmotic member, which, when heated, allows Hydrogen to flow into the tube, if the density is greater on the outside, such as in the lowering bulb, and out of the tube, if the density is less on the outside, as in the raising bulb.

It is understood that the raising bulb is open to free air circulation and therefore there is no Hydrogen in contact with the outside of the osmotic member. The outside of the tube therefore acts as a perfect vacuum to Hydrogen flowing outward. Although the air pressure is fifteen pounds per square inch, it exerts no influence upon the outflowing Hydrogen because it is not in solution with the palladium and therefore has nothing to do with the osmotic action.

The French have championed the osmotic regulator because of the steady operation of such tubes and their general good qualities, having gone to some trouble to develop automatic mechanism to move a spirit lamp to and from a palladium tube, which is heated by the flame which supplies the Hydrogen. The method seems cumbersome and complicated, but the results good until the palladium tube and the anode, by use, give off other gases, due to inadequate pumping and refining.

The simplicity of the new Hydrogen tube renders it very practical and adaptable to high tension circuits as installed in most Roentgen laboratories. The osmotic member of the reducing bulb is surrounded by pure Hydrogen at atmospheric pressure and sealed to form an integral part of the tube. It contains enough Hydrogen to regulate 1500 times. At normal temperature, Hydrogen does not penetrate the osmotic member. When heated with a spark simply by throwing over the cathode terminal to the regulator wire in the usual way, a current of 20 to 25 milliamperes heats the osmotic tube to redness, at which temperature pure Hydrogen passes through the pores of the metal into the main bulb.

To raise the vacuum, the regulator wire is simply transferred to the raising bulb and heated with 20 to 25 milliamperes, the same as to lower it. If a heavy shunt spark jumps across the regulator, as will occur occasionally, the tube is not impaired in any way as would be with a sensitive chemical or mineral regulator which would lower the tube to a useless vacuum and require repumping.

A separate regulating transformer makes it possible to raise or lower the vacuum by a switch on the Control Stand and that without interruption of the main current through the tube.

Other types of regulators using asbestos, chemicals, mica and other minerals give off complex gases, especially after moderate use, which makes the vacuum "cranky." The spark as it passes through the regulator, selects the path of least resistance which it follows in subsequent regulations, ignoring the body of asbestos rich in gas. The result is, burned asbestos, devitrified glass, and a dry insensitive regulator, which gives off complex gases of high electrical resistance and poor penetration.

The *air* regulator admits oxygen which makes an unsteady vacuum because of its chemical affinity for copper with which it forms oxides.

With nothing but pure Hydrogen ever entering the main bulb, its electrical and penetrative characteristics remain uniform indefinitely.

Quality of penetration is commonly measured by the parallel spark which indicates

electrical resistance, whereas penetration is more a function of electron velocity.

Hydrogen has such a low electrical resistance that it gives good penetration for a relatively short parallel spark.

Excellent radiographs of the head are being made at a parallel spark of only four inches on 40 milliamperes.

Penetration changes are small with comparatively wide variations of current. A tube at a four-inch vacuum with five milliamperes backs up about four and three-quarters inches at 20 to 40 milliamperes.

Thus it gives off a comparatively homogeneous beam of rays over a wide range of current and a fluoroscopic examination may be followed by a heavy exposure with only a moderate change in the quality of the rays, simply by increasing the impressed voltage with the rheostat.

This is impossible with the electron type of tube, as described by Dr. Coolidge in the Physical Review of December, 1913, who says: "If the temperature of the filament is low, only a small number of electrons escape from it and, consequently, only a small discharge current (the saturation current) can be sent through the tube. Increasing the impressed voltage above that needed for this current value causes no further increase in current. It simply increases the velocity of the cathode rays and hence the penetrating power of the Roentgen Rays."

The same is true of Dr. Lilienfeld's design of electron tube, as proven by personal experience. It would therefore require an extra operation of resetting for the supply of electrons to maintain the quality of penetration within the same range for an equal change of current. The Hydrogen tube has an enormous saturation current because of the copious supply of electrons available from the molecules of the gas. Further analysis of the electron tube indicates that with a rectified sine wave, such as approximated in the exciting apparatus of today, the saturation current might be reached shortly after the potential wave has risen above zero. As it continues to rise to its maximum, there would be no further increase of current, but the quality of radiation would change with each increment of increase of potential, giving rise to a heterogeneous beam of rays. Thus the average penetration might easily approximate that corresponding to the average potential of a sine wave which is 0.637 times the maximum.

In other words, an electron tube excited by a pulsating sine wave might back up ten inches parallel spark, and have an average penetration corresponding to a parallel spark of about seven inches while the milliammeter is indicating a constant value of current.

Further comparison is to be made in reference to the fixity of the position of the focal spot.

Dr. Coolidge claims for his design of electron tube that "The focal spot on the anode does not wander, but remains perfectly fixed in position." Also, that "This is in sharp contrast to the ordinary Roentgen tube in which the focal spot does move about—." The pin hole radiograph proves the contrary true of the Hydrogen tube.

It verifies the fixity of the focal spot in the electron tube, but proves that that portion of the anode extending into the main bulb, about three inches long, is a prolific source of X-Rays as evidenced by the dense image which it made on the plate. (See Figs. 2 and 2-a.)

The principal advantage of the anode extension ring in the Hydrogen tube is probably its indirect protection to the glass of the cathode neck.

It tends to produce a symmetrical electrostatic field about the cathode which holds the axis of the canal stream straight and coaxial with that of the cathode. This results in a concentric distribution of heat in the cathode which is radiated uniformly to the glass which surrounds it. As is well known, glass will stand high temperatures if heated slowly and uniformly, but steep thermal gradients are dangerous. Evidence of this phenomenon may be found in the circular

concentric heat coloration of the cathode face of tubes, constructed with the anode extension ring and the irregular shaped, excentric coloring on those without it. (Fig. 4.) In the air-cooled type, air channels are so arranged that the anode, cathode and glass receive a cool blast of air of such pressure and volume that the tube may be run continuously with ten milliamperes at a parallel spark of four inches. In one test as high as twenty-five milliamperes were passed through the tube for one-half hour without any signs of deterioration, the glass being cool enough to touch at any place without discomfort.

It is a significant fact that in all tests conducted with air-cooled Hydrogen tubes of the present construction, none have ever been "cranky" or cracked at the cathode neck.

In another test it ran 4 hours continuously with 10 milliamperes at a parallel spark of 4½ inches. This is equivalent to 4 x 60 x 60 x 10=144000 milliampere seconds. If we assume an average exposure of 50 milliamperes for 2 seconds equal to 100 milliampere seconds, the tube made the equivalent of 1440 exposures and to all appearances was good for at least an equal number more.

The development of this tube is due to the joint efforts of Mr. H. Clyde Snook and the writer.

SUMMARY

1. The most efficient gas is chosen.
2. Means to exclude all gases except the one chosen.
3. Never "cranky" because no inefficient complex gases ever enter the bulb.
4. Detail of construction, and method of heating which renders the osmosis regulator sensitive, simple and reliable.
5. Regulator to both raise and lower the vacuum.
6. Only moderate change in resistance with increase of current.
7. Vacuum regulated from Control Stand.
8. Glass and Electrodes cooled in such a way as to allow continuous operation on heavy currents.
9. Comparatively homogeneous beam of X-Rays over wide ranges of current.
10. Good penetration for comparatively low electrical resistance.

HYDROGEN X-RAY TUBE AIR COOLED

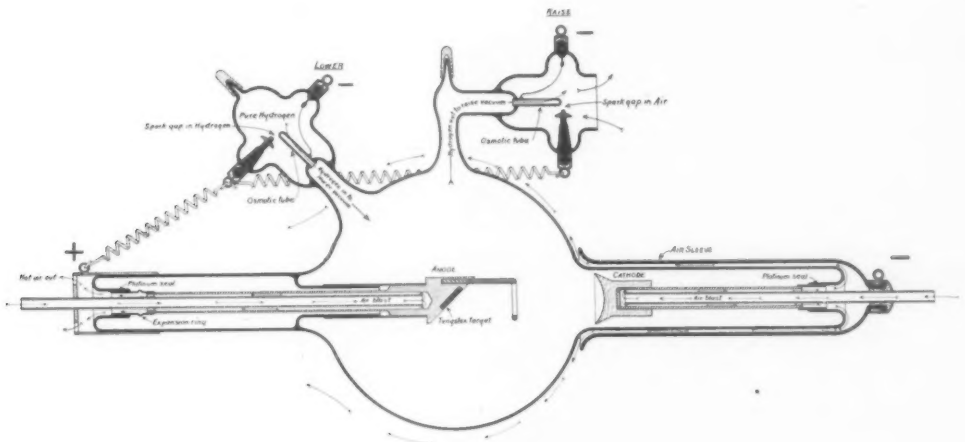


FIG. 4

THE "BOILER" SYSTEM OF WATER CIRCULATION APPLIED TO WATER-COOLED ROENTGEN RAY TUBES

By JOHN M. GARRATT, M. D., Buffalo, N. Y.

The requirements necessary for successful deep Roentgen ray therapy are well known to the readers of this journal and to repeat them would be time consuming and unnecessary. Nor will we attempt to enumerate the objections to the usual apparati used to maintain a circulation of water in the bulb of a water-cooled tube.

The usual system for obtaining a hot-water supply in the residence; namely, the kitchen boiler and water-back, is the basic principle applied to the subject at hand. The "Boiler" so-called is simply a storage tank, into the upper part of which the hot water, heated at the anode, rises; the cold water flows, with a head of about 15″, through the lower stop-cock and connecting tube directly to the back of the anode. All that is necessary to maintain a circulation of water is to heat the anode; the larger the diameter of the tubing and connections the more rapid it will be. We have found that if the smallest diameter of the circuit is ¼″ satisfactory results will be obtained. The precaution of having a solid column of water, with *no air bubbles*, is essential. We prefer rubber tubing connections, instead of the all metal as suggested by Dr. Pfahler, to allow of "milking" to force out bubbles of air and the application of a tube compression cut-off to facilitate the removal of the tube from the tube holder.

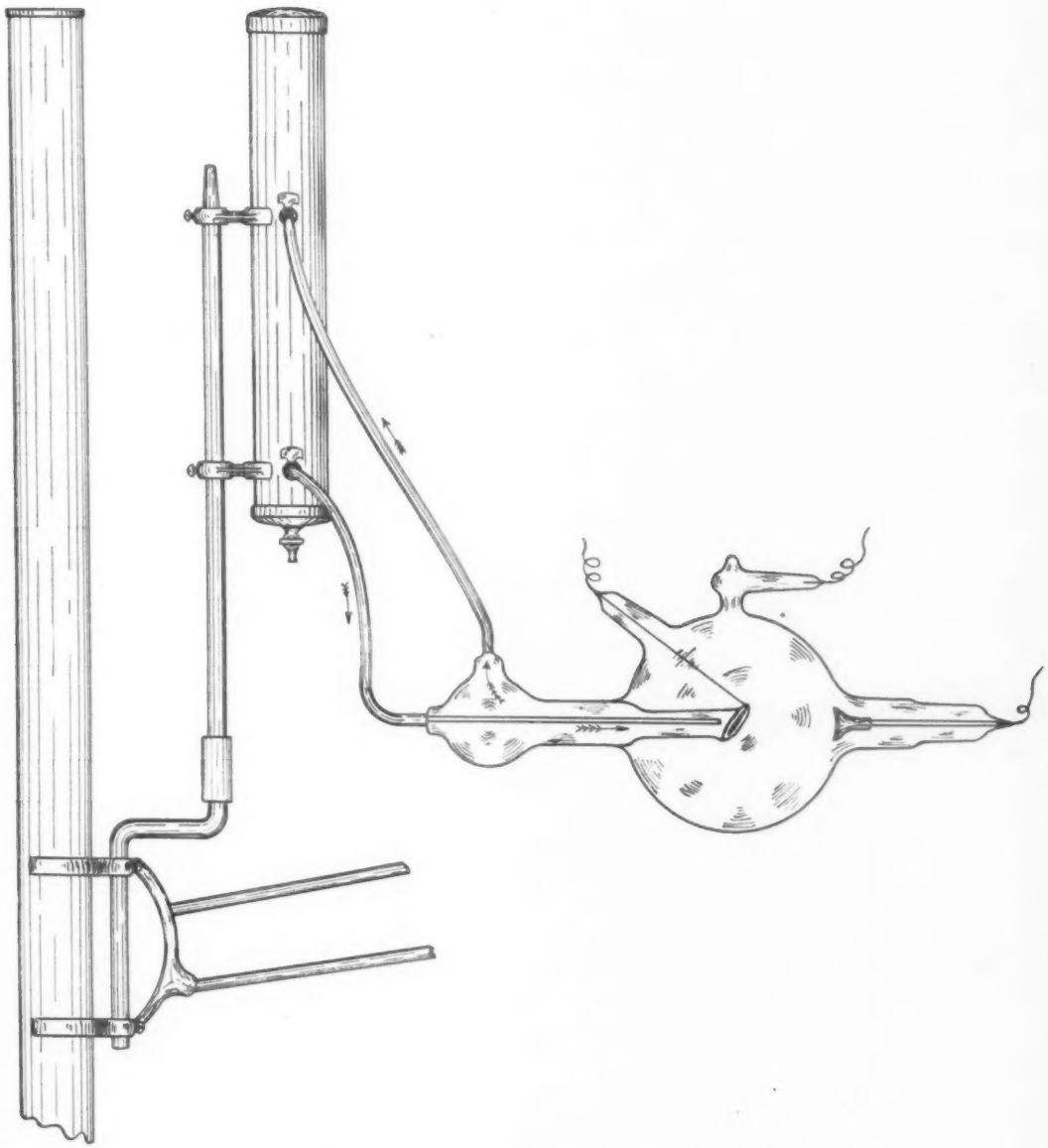
With three M. A. of current passing through the tube there will be no change in the milliamperage after hours of use. Using a greater amperage, if the vacuum lowers it is due to radiation of heat from the cathode. Should the water in the tube become too hot it can be easily and quickly replaced.

THE TANK is made from a thin brass cylinder, 19″ in length with an inside diameter of 3″. An automobile radiator-cap, of sufficient diameter, can be utilized for the bottom and cap; to the former is fitted a draw-off cock, in the latter a vent hole is provided. Two stop-cocks having a ¼″ bore are placed, one 2″ from the bottom and the second 9″ above the first. At right angles to each stop-cock is attached a lug for the insulating supporting rod. This rod is of fibre, 19″ in length and 11/16″ in diameter at the base. Four inches from the top it tapers to 5/8″, the upper lug being slightly smaller than the lower. The base of the rod fits into a metal receptacle attached to the upper end of a solid rod ⅝″ in diameter, bent to allow a clearance of three inches from the upright. The rod fits into lugs which are screwed to the tube carriage.

The capacity of the tank is about 3,000 C. c., and the bulb of the tube 500 C. c., making a total of 3,500 C. c. of water to be displaced in circulation.

The cost should not exceed $15.00.

Looking through the literature we are unable to find any reference to previous adaptation of this method of water circulation to Roentgen ray tubes.



To Illustrate Dr. Garratt's Article.

CLIP FOR HOLDING DENTAL AND OTHER FILMS DURING DEVELOPMENT AND DRYING

By SINCLAIR TOUSEY, A. M., M. D.

This simple appliance is the bull-dog window clip No. 120 A. N. C. of the stationery stores. Its serrated edges hold the film firmly even by the extreme edge or corner. The curved handle hooks over the edge of a flat tray in which the film lies or over the edge of a deep tank in which it hangs and later over a rod upon which the film is hung up to dry. The whole process including shaking the film in the different solutions to remove air-bells and insure uniform development and taking it out of the developer to observe the progress of development, can be accomplished without wetting one's fingers. The ease with which it is applied even in darkness and the permanence of its hold are features that make it better than anything I have used heretofore.

850 Seventh Avenue

MIDWINTER MEETING AT ATLANTIC CITY

This was the outcome of a meeting of Philadelphia and New York members, held in Philadelphia in November, at which a committee was appointed to arrange for an informal meeting at Atlantic City. The meeting convened at the Hotel Chalfonte at 8:30 P. M. Friday, January 29th. Dr. Geo. C. Johnston was chosen chairman. No secretary was chosen, it being the object to keep the meeting purely informal without any new organization and without putting the speakers on record. About eighty roentgenologists were in attendance, over seventy of whom were in the room at the first session.

The topic for discussion on Friday evening was "The Roentgenologist and the Hospital." This proved most interesting. Many speakers told of many things they had suffered from many hospitals, while, somewhat less often, one would arise to praise his own berth. The discussion continued well into the night only to be continued still later by groups as the session adjourned. A committee, Drs. W. H. Stewart, Pancoast, Baetjer, Case, and Holding, appointed to formulate resolutions to embody the gist of the discussion, drafted the following, which was read and adopted at a later session:

Copy of report of Committee appointed by the Chair at the Mid-winter meeting of Roentgenologists to consider the subject:

THE ROENTGENOLOGIST AS A CONSULTANT

It is the sense of your committee that the interests of Roentgenology would be advanced by the adoption of the following principles. The subject naturally divides itself into two divisions, namely:

The relation of the Roentgenologist to the referring physician or surgeon

and

The relation of the Roentgenologist to the patient

The first division, "The Relation to the Referring Physician or Surgeon," has been sub-divided and the following conclusions reached: That a written report should be given on every case examined. That it should consist of, first, the Roentgen findings and, second, the conclusions—these conclusions to be based only on the Roentgen findings. That no recommendations should be made except by special request. That it is the sense of the Committee to discourage the routine giving of plates or reproductions.

The second division—"The Relation of the Roentgenologist to the Patient"—is thus expressed: First, That no report should be given to the patient except through the referring physician or surgeon. Second, That patients are sent for consultation and diagnosis and are not entitled to plates nor prints. Prints in the hands of patients lead to false interpretations, confusing opinions, multiplicity of advice and bad results.

(Signed) W. H. STEWART (Chairman)
F. H. BAETJER,
H. K. PANCOAST,
A. F. HOLDING,
J. T. CASE.

February 8, 1915.

SATURDAY MORNING

Brief papers were read by the following:

Dr. Chas. Eastmond, Brooklyn, Roentgen Diagnosis of Cardiospasm.

Dr. Arial W. George, Boston, Some Interesting Cases.

Dr. Geo. E. Pfahler, Philadelphia, An Improvement in the Technic of Gall-Bladder Examination.

Dr. Jas. T. Case, Battle Creek, Multiple Diverticula of the Colon.

Dr. L. T. LeWald, New York, Anomalies of the Ribs and Spine.

Dr. F. B. Granger, Boston, Further Results in the Production of Sterility by the Roentgen Ray.

These papers will doubtless appear in the medical press.

Prof. J. S. Shearer again delighted his hearers with an informal talk illustrated with charts of curves from studies in X-ray currents, tube penetration and behavior, and comparisons of timing devices.

Dr. Selby showed a tubular cryptoscope with a device for securing film roentgenograms of the region seen fluoroscopically.

SATURDAY—P. M.

The informal discussion upon the topic, "Recent Experience with Roentgen Therapy," disclosed some radical differences in technic and even in dosage. There was, however, practically agreement in the end upon a technic and dosage approximately as follows:

Spark gap.	Filter aluminum.	Leather.	Focus-skin distance.	Milliam.	Time.	Kienbocck.
8-9 in.	3mm.	1	7-8	5-6	3 min.	18-20

Repeat in three weeks and every four weeks thereafter until disease is controlled. Caution was urged by nearly all the speakers that in using massive dosage all these factors be carefully watched to avoid the danger point. Care in the selection and reading of radiometers was urged by many. It was evident that the tendency is now to look forward to some direct method of measuring tube energy as the basis for computing dosage.

The discussion later turned to the Coolidge tube. There seemed to be agreement that, output and penetration being equal, all tubes, whether of gas or electron type, will be equally dangerous in the production of secondary rays; and that if high penetration and large output are to be used, thicker and more extensive protection must be provided. Dr. Coolidge spoke of the possible development of a very small electron tube insulated in oil, which in turn might be water-cooled. He also talked entertainingly upon the attitude of large corporations toward scientific development. While much of the research is regarded as an allowable amusement permitted for expert employes, it is not uncommon for directors to become enthusiastic in following the experiments.

Saturday evening was devoted to lantern slides. The lantern furnished and operated by Dr. Thos. S. Stewart was unusually good. Dr. LeWald showed several stereo lantern slides produced by the two-color method. Spectacles were furnished, having the complementary colors, and the demonstration was quite a success. The plan has often been mentioned, but actual demonstrations of it have been rare. Other slides of great interest but too numerous to mention kept the attention of a well-filled room well on to midnight.

A vote taken at this session showed a practically unanimous sentiment for a similar meeting at Atlantic City next year, and the Chair was asked to appoint a committee of arrangements. He reappointed the committee which arranged this meeting, Drs. Bowen, Jaches, Pancoast, Imboden and Westcott.

A large number remained at the hotel until Sunday afternoon.

A creditable manufacturers' exhibit was held during the meeting and did not lack for attentive visitors.

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EDITORIAL

January 23, 1915

Dr. P. M. Hickey,
Editor American Journal of Roentgenology
Detroit, Mich.

Dear Doctor:—

As chairman of the Committee to arrange for a combined midwinter Roentgen meeting and a meeting of the Chicago Medical Society to be devoted to X-ray subjects, I have been asked to write a short account of what we expect to do.

The meeting is to be held Wednesday, March 3rd. In the forenoon there are to be a number of papers on X-ray subjects, the titles and authors to be announced later. The afternoon is to be given over to the showing of slides as formerly and general discussion on these. Following this it is proposed to have an informal dinner to promote the social spirit amongst the members. The evening meeting is to take the place of the regular weekly Chicago Medical Society meeting and is to be devoted to the subject of Roentgen Therapy. Dr. Pusey will speak on the Roentgen Therapy of skin lesions, Dr. Case on the Deep Therapy of non-malignant lesions and Dr. Pfahler on the Deep Therapy of malignant lesions. On the following day an attempt will be made to hold X-ray clinics at various hospitals for those who can stay over.

Very truly yours,
ADOLPH HARTUNG,
Chicago, Ill.

The place of meeting will be announced in later postal.—[Ed.]

To the Editor of THE AMERICAN JOURNAL OF ROENTGENOLOGY:

Esteemed Sir:

A few weeks ago, I received an October issue of the American Roentgen Ray Journal which has been forwarded to me to this place. Every sign of scientific solidarity presents itself as a benevolent act in the midst of the fearful war in which European humanity is lacerated. I should like to tell the American Roentgen Ray Society, which made me an honorary member, what infinite blessing roentgenology means for the treatment of the poor wounded. Roentgen apparatuses can scarcely exist in a sufficiently large number. The quick and painless diagnosis of injuries to the bones, the possibility to exactly locate projectiles places roentgenology at the head of war medical means. Cookes discovered the Cathode-rays, Roentgen the X-rays. This fact, better than anything else, proves the absolute neutrality of medicine and natural sciences which must exist for the benefit of all nations. We scientific men send our greeting to the neutral and high-minded America! The Christmas ship for the children and all other efforts toward peace, which America desires for us, have not remained without effect. May America, in the name of humanity and of the One God continue to proceed on this way for our benefit and for the benefit of the coming generations.

Devotedly yours,
Dr. Schwarz Gottwald,
p. t. Graz, Garnisonospital
No. 7, Austria.

ABSTRACTS

Holzknecht: Localization of foreign bodies (Fremdkorper-lokalisation). Munchen. med. Wchnschr, 1914, lxi, 2197-2200.

Peace has already prepared us for the two chief uses of roentgen examination in war. To be sure fractures show a surprising characteristic, which is due to the lack of force of the body causing the fracture, and therefore we do not find the extensive dislocation that we do in civil fractures, but in place of it there is more abundant fragmentation. It may be compared to the breaking of a mirror by throwing a stone through it, but the fragments are held in place by the frame. But this characteristic does not demand any other roentgenological procedure than the fractures of peace. All indications are fulfilled by the taking of two pictures in as nearly perpendicular directions as possible at the place of the external opening of the wound and the pain. Neither is the interpretation of the pictures difficult and mistakes of any consequence are rare. Men practiced in illumination can accomplish all that is necessary by illumination alone, except in a small percentage of insignificant fractures.

It is different with the question of foreign bodies. Of course the finding and removal of bullets is not the chief field of war surgery, but it has been found, often contrary to expectation, that "Quieta non movere" is not adequate. Pain and disturbance of function may result from bullets lying superficially between the skin and parts of the skeleton or near to tendons, joints or important organs, and in infected regions the foreign body is an unwelcome guest. Therefore long before deciding upon the surgical indications, it is a question of diagnostic importance whether a part of the numerous symptoms are due to a bullet lodged in one or another of the above mentioned locations. Besides the reports as to whether bullets have penetrated or remained in position are unreliable, and also those that foreign bodies have been removed, for often the removal has been incomplete, only superficial fragments having been removed. Frequently bullets entering the shoulder girdle are found in the organs of the thoracic or abdominal cavities, as a result of the prone position on the firing line. Therefore before any intervention is decided upon foreign bodies must be demonstrated and localized.

The former is easy, for any good plate shows the finest splinter distinctly. But it is unfortunately just as evident that it shows it in a wrong position. In looking at a picture one gets the impression that the projectile lies in the plane of the part of the skeleton next to him, and is distant from it about as far as it appears to be in the picture. (Note 1. Due to an optical illusion of psychic origin: a tendency to select the easiest and simplest of several different, indistinguishable possibilities.) Every physician now knows that this impression is false and that a second picture taken in another direction substitutes another false position. But unfortunately almost all believe, even those who have considerable experience in roentgenology, that from two such pictures the position of the projectile can be determined. This is false, and so false that many grave errors must arise from it. In spite of that most localizations of foreign bodies are made in this way, and surgeons who talk of the care of the wounded and count radiology as one of their resources, praise this mistaken idea as a valuable accomplishment and consider special methods superfluous. But now after several weeks' military activity it is generally conceded that surgeons really in practical cases are very much dissatisfied with the roentgenological localization of foreign bodies. A great percentage of vain searches have been brought out and there results great uncertainty and disinclination to operative procedure.

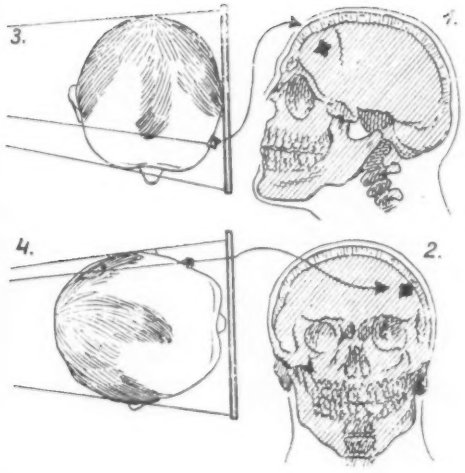

FIGURE I. Tracings from two roentgenograms of a head. In diagrams 1 and 2, the projectile appears to lie within the cranial cavity. In diagrams 3 and 4, it is seen that the projectile is fastened with adhesive plaster to the hair at the boundary of the temple and frontal areas.

First let us show that the above idea is false. Fig. I, 1, a lateral view of the skull, and Fig. I, 2 an anterior one, both show the shadow of a foreign body. The great majority of observers would say that there was a foreign body in the cortex of the brain at the boundary between the temporal and frontal. Some of them even tell the exact convolution—I have tried it many times. But I only fastened the foreign body with adhesive plaster to the hair of my assistant at the boundary between the temporal and frontal. It is quite natural that it should appear to be inside the skull, as is shown by Fig. I, 3 and I, 4, and the projection lines.

The cause of this error is the same as it is in looking at one picture; though the pictures may be taken in any two chosen directions, this greater complexity is no guarantee of accuracy. The truth is not simple but it is complex in a different way. A foreign body is not proven to lie in a hollow cavity when it seems to lie in it in two or three projection directions but only when it does not lie outside it in any one of all the possible ones. But all possible projection lines cannot be represented by means of pictures, but only by means of fluoroscopy; but with this it can be done easily and quickly.

I know of only three methods of localization that can be utilized practically: I. Illumination with constant rotation of the body to determine (a) the nearest point on the skin to the foreign body and (b) the nearest bone point to the foreign body. (First proposed by Holzknecht and Gruenfeld.) II. Illumination in two directions crossing each other obliquely, marking the four points on the skin where the rays from the foreign body come through. (First proposed by S. Exner.) III. Double picture on a Wachtel plate, a new instrumental method of localization, which is more accurate than the more complicated older ones and the execution of which is simple. (Apparatus by Sommer—Wien VII.)

The two first will be described. (Note: The third will be described by the author himself. It belongs among the methods of exact measurement described in the literature, all of which — I will not enumerate them — cannot be used practically in war on account of their complexity. The latest by Robinsohn, which is really simple of execution, necessitates a change in our methods of illumination.)

Fluoroscopy is common to both of them. It is necessary because "by turning the hand" it gives all directions and because it permits of transference to the skin. The result is that it gives skin points and information as to direction and depth, for example: "The object lies in such and such an organ, perpendicularly 5 cm. deep"; it does not give two pictures as food for the imagination. (Note: Even stereoscopy does not give what the diagnostician and surgeon wants.)

As to the danger of fluoroscopy, and especially such numerous ones as are demanded for this purpose, it may be said that our simple fluoroscopy apparatus (Beclere stativ, klinoscope, Wiener model) are so arranged that they give completely adequate protection. The hanging diaphragm and diaphragm case allow only a cone of light

from the direct light to pass through and touch the patient. The light coming from him is received by the lead glass of the illuminating screen. The physician is struck by the secondary rays and a few that penetrate the lead glass. It is not true that he is injured by them. All injuries have been from careless lighting with direct light in the early days before the action of the rays was understood. The fact that some pioneers in the work without proper protective measures have suffered injury and that these injuries are now naturally showing their bad late results, should not lead us to scoff at the present adequate measures for protection, nor to exaggerate the need for protection to such an extent as to create apparatus that hinders the work or makes it almost impossible. In the 6, X, 1914, number of the M. m. W. Moses, by several incorrect statements and picturing an unbelievably bad use of fluoroscopy, discredited this important method, and by exhibiting a new apparatus made the non-possessors of such a one feel uncomfortable, instead of giving the simple advice, as he should have done, to keep the diaphragm so narrow that the whole cone of direct rays should be received by the screen. For that was the only mistake. Unfortunately such errors meet with much sympathy, for they support the disinclination for fluoroscopy on the part of those who have no skill in it. The number of the latter is great, for, as looking at roentgen pictures is easy, our specialty has about 90 per cent dilettantes, who, of course, are not prevented by what they do not know from announcing themselves as experts. I am a partisan of fluoroscopy, but that is because I understand it.

Which method shall be used in individual cases? The first (rotation) should first be used in every case. It can generally be used and then the others are superfluous. If it cannot be used then the second (4 points) can. If this is not accurate enough on account of the great number or smallness of the foreign bodies or on account of the importance of the organ involved, then the third is used. (Double picture by Wachtel's method.)

1. Illumination with constant rotation:

Illumination of the standing or sitting patient for the head, neck, thorax and upper extremity or on the table for the lower extremity or for very sick patients. Light as in deep therapy on all suspicious places and all markings with narrow diaphragm. We see the foreign body, turn the part of the body (Fig. I, 1-3) and see either (a) that the foreign body in many positions comes near to the surface of the body or (b) that it remains near the skeleton. Accordingly we make the diagnosis of (1) localization on the skin or (2) on skin and skeleton.

I, a. Localization on the skin: Keeping in the eye the distance on the screen between the shadow of the foreign body and the contour of the skin we turn the part of the body this way and that (Fig. II, 1-3) and note the positions in which the skin-foreign body distance is the smallest. That position in which it is the smallest we keep, for it gives the true skin distance of the foreign body. (Note: Only increased a little by the divergence of the rays. This is either disregarded or measured very simply and satisfactorily by the following method proposed by Robinsohn: The colored pencil which marks the skin point is surrounded by a metal tube that can be shoved up and down on it. After finding the skin point the tube is pushed far enough toward the skin so that its distance from the skin is equal to that of the foreign body. Looked at without roentgen light the distance of the tube from the point of the pencil now gives the true depth of the foreign body.) If we turn past this point in the same direction the distance becomes greater again, so we turn back to the point already found. (Note: In reading this part of the work we recommend as a model of the body an empty water glass with a lead pencil fixed in it. A practice model for lamp instead of roentgen rays is made by Sommer, Werkstaetten fur Wiener Roentgen-modelle

Wien, VII.) We now draw the skin-foreign body distance with a greased pencil on the screen (——). We keep the position of the body though, for we know now the true depth, but not what skin point it lies under. We determine this point by taking a pencil-shaped indicator and holding it so that it touches the surface of the body (or dressings), then we slide it back and forth, now nearer to the screen, now nearer to the tube. We see that its point generally lies within the shadow of the soft parts (Fig. II, 4) and in only a few positions is its whole length free to the point (Fig. II, 5.) (Note: If there are dressings, even free of the contour of the soft parts.) We keep this position of the pencil for its point now designates the skin point that holds good for the above depth; the bullet lies perpendicularly below it at the depth found above. It is marked with a silver nitrate marking pencil. This is transferred from the dressings to the skin when the dressings are changed; if the dressings are soft they are held firm with the finger while the remaining dressings are cut away, or if they are rigid a ring is placed around the point. Depth written with silver nitrate on the skin which has previously been moistened with photographic developer by means of a pledget fixed on a stalk.

When the point is marked we try by pressing in on the pencil to see if the foreign body cannot be moved with it. (Note: Naturally where no rigid walls, as skull or thorax, lie under it.) In this way we often find an even more accurate point in the near neighborhood of the first (Point where there is the greatest movement of the foreign body). In conclusion we try to see if the foreign body is not palpable at the given point, which is dependent chiefly on the nature of the underlying tissues.

I, b. Localization in the skeleton or a visible deep organ (Or on a part of the digestive or urinary tract made visible). The same procedure. We turn the part of the body in every direction until the foreign body shadow detaches itself from the bone shadow. The greatest distance thus found is the true distance, for instance 1 cm. It is noted and the position held for we now have to determine the surface point of the bone which is now turned toward the shadow of the projectile. For example the planum popliteum, 5 cm. above the external epicondyle. (Note: For this we choose a point on the skeleton that is readily visible by roentgen rays as well as accessible to palpation.) We then add the surface point and the depth according to method I, a.

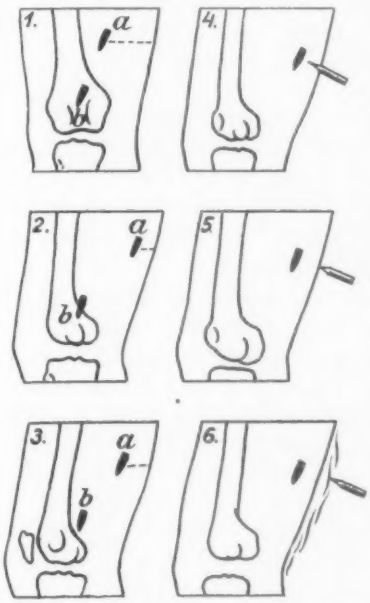

FIGURE II. Diagrams 1, 2 and 3 illustrate rotation of the part to determine the shortest distance between the foreign body and the skin, which is shown in Diagram 2. Diagrams 4 and 5 show how, with the part held in the position shown in Diagram 2, one moves the shadow-casting pencil over the skin until it is evidently free. Diagram 6 shows the position of the pencil outside of the dressings.

We can with much advantage add the so-called opposite point if we cover the skin point found (cross marked) with the visible point of the greased pencil and then turn the body so that the marker and the projectile coincide. Now we mark the projectile on the side of the body opposite the skin point (Ring: asterisk, mark). In conclusion we add our opinion as to the organ or part of an organ in which we know or

think the foreign body to be located. The findings may run for example: 3.5 cm. perpendicularly under the lapis point lies an artillery bullet that is not deformed. It is 2 cm. from the planum popliteum, 5 cm. above the external epicondyle. It lies 4 cm. from the lapis cross in the popliteal space in the direction of the lapis ring on the patella when the knee is extended. Region of vessels and nerve trunks.

These and other details may be added if we once get hold of the principle. For example we can locate a projectile on the inner surface of the skull. Depths stated in this way will have much more value for the neurologist and surgeon than those relating to the swollen soft parts. The method is the same as in localizing on the skin; the smallest distance is the true one. All these things are impossible with pictures.

Two consequences that follow as a matter of course: a projectile lies outside a spherical cavity (thorax, skin, bone surface) if it is seen outside in any one position of the body. It lies within it if it is seen inside it in all directions—not in one, which is the fundamental error of plate localization. The cavity must be bounded either by a plane surface or one that is concave inwardly; if its boundary is anywhere concave outwardly (pulmonary side of the diaphragm), the above is not true and the localization must be made according to the same rules on the convex side (in this case the abdominal side).

If with this first method before we have with certainty found the smallest skin distance or the greatest bone distance, we come upon a position in which the foreign body is not visible (body transverse or poor light), and if beyond this position we cannot be sure that we have found the smallest or greatest distance, then this method cannot be used and we turn to

II. Illumination in two directions oblique to one another with marking of the four skin points. It can also be added with advantage as a control to the deep localization of I, b.

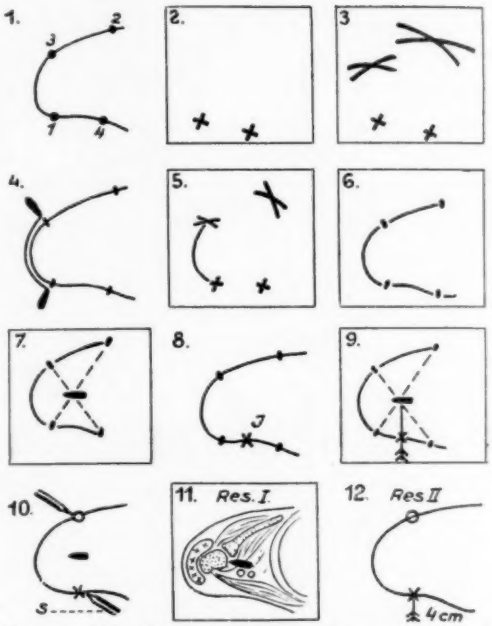

FIGURE III. Illustrating the four-point method and its application to a cross-section of the shoulder joint. See the text. X—the incision; S—screen; Res—result.

Of the positions obtained by turning (method I) we select two, in both of which the foreign body is clearly visible, and whose angle to each other is as large as possible (as near as possible to a right angle). But often an angle of 30 degrees is the largest possible, and then one position appears in which the foreign body is invisible. We then take the first of the directions, illuminate and warn the patient to keep as quiet as possible, and even hold him so with the hands, and do not release him from this position until we have marked, for example with two crosses, the places where the foreign body shadow and the point of the pencil coincide, both anteriorly in front of the screen and on the opposite side of the body. Many mark the posterior point after turning the patient around so that the colored pencil can be seen better; but then the same direction of illumination is not guaranteed. Now we turn to the second position and proceed in the same manner, marking with two rings. It is well to test the result by placing the pencil on the one mark, bring the

foreign body into coincidence with it, then bring the pencil into position for the second mark and see if it really falls upon the one previously made. The same thing should be done in the other position. The result may be seen in the transverse section of the shoulder (Fig. III, 1).

These four points are used (a) to determine the position of the foreign body by eye measurement, (b) to locate it on a cross section drawing and (c) to determine the depth and direction of the incision to be made. (See Fig. III.)

(a) By looking at the four points or by placing a finger on them and connecting the pairs of points by an imaginary line, we can form a judgment as to the point of intersection of the lines, at which the foreign body lies. This can be supplemented by placing four indicators, lead pencils for instance, on the four points and arranging them so that they point toward the opposite point of the body.

(b) Cross section drawing (Fig. III, 2-9). For this we use a large compass. (Note: School compasses may be used, or better yet a gynecological pelvimeter, to which a lead pencil is attached by means of adhesive plaster.) With these we take the distance of two neighboring points and transfer them to paper (Fig. II, 2), then the distance of these two points from a third and fourth, that is four distances, set one limb of the compass on the first and second points and describe with the second the arc of a circle. (Fig. III, 3.)

The two points of intersection of the arcs correspond to the third and fourth skin points. We now take a flexible metal strip (Note: Preferably lead foil 3 mm. thick, 2 cm. broad and 50 cm. long) and adapt it to the contour of the body, mark the skin points, lay it on the drawing and follow the contour of the body with a lead pencil. (Fig. III, 5.) Now we have an outline of the body contour with the four points designated on it (Fig. III, 6). If we connect these points with intersecting lines (Fig. III, 7) the point of intersection is the site of the foreign body. Its distance from any point on the surface can now be measured with a rule.

(c) It is only a special case of this when the physician, having determined the position of the foreign body by the cross section drawing and the four skin points made permanent with lapis, sets about determining the depth and direction of the incision to be made. (Fig. III, 8, J.) Without any further roentgen examination we proceed to measure with the compass or lead foil strips the distance of the newly chosen incision point from one of its old neighboring points (Fig. III, 9), and transfer it to the drawing, and from this the line is extended on the one side to the foreign body (point of intersection) and in the opposite direction over the contour of the body. The prolongation gives the direction in which the incision must be made. The depth can be measured directly with a rule. Surgery prefers perpendicular incisions. However oblique ones are sometimes made when anatomical conditions demand it. In such cases and also when the word "perpendicular" does not have any very definite meaning on account of the manifold surface formations, the direction from the point of incision to the foreign body must be more accurately defined. It is best described by making use of the "opposite point" on the opposite surface of the body. (See I, b.)

III. Double pictures by Wachtel's method, which, as has been said, the author will report.

Methods I and II can be used even in the most hastily improvised roentgen rooms. It only takes a few minutes. We should always keep in mind that, though for diagnostic purposes we need only to know the organ and part of the organ in which a foreign body lies, for surgical purposes we must also determine a point purely geometrically, independent of anatomical considerations, from which an incision can be made, and also the direction of this incision and the depth at which the foreign body can be found. For this purpose we must make use of all available methods, and not be content with those in ordinary use.

THE PLATE EXHIBIT AT CLEVELAND

One was impressed, first, by the general technical excellence of the plates shown. It could be readily noted, too, that the members are no longer greatly interested in plates simply because they are "good plates," but wholly because of the information they give.

Both in quantity and quality, in the number of members represented, and in the unusual interest of the plates, this exhibit easily surpassed any that have preceded.

It was perhaps not surprising that 35% of the plates shown should have been of the alimentary canal, but looking at this array, it was a little difficult to realize how impossible most of these would have seemed only five years ago.

With all this interest in the newer lines it was encouraging to note that 20% of the plates were concerned with bone and joint conditions, and the great variety of unusual conditions shown was convincing proof that even in bone work, which the general profession is prone to consider simple, the technique has not yet arrived at the "push-button" stage.

There was a noticeably small space devoted to lung conditions and it is not improbable that the next great advance may be in this region.

The number of plates shown of any given subject can, of course, be considered only as a very indefinite index of the general interest in that subject. At no point is this more apparent than that of Roentgen therapy. There is great difficulty in recording roentgenographic or photographic results of the newer therapy, but there is still missionary work to be done in the older fields and too much of the success in Roentgen therapy is unrecorded. Dr. Holding's "before, after, and photomicrograph" exhibit is worthy of imitation.

Speaking of missionary work, the splendid exhibits of stereo-reductions by Dr. Dunham and by Drs. Caldwell and Imboden were most suggestive. Armed with such illustrations, our papers before general medical assemblies cannot fail to be more impressive.

Two "puzzle plates" attracted much attention and, doubtless, many did not get at the true interpretation. In one of the stereo reductions by Drs. Caldwell and Imboden, the shadow which so much resembled a doughnut in the right iliac fossa was that of a roll of bandage used to force the cecum upward. The plate by Dr. Cole, a stomach study, with general mottling, was made of a patient who had received numerous injections of an iodine preparation for therapeutic effect.

In addition to the official exhibit, there were five private exhibits. Dr. Case showed a number of intestinal conditions reproduced on films, a plan which looks attractive to anyone who has experienced the disappointment of having his exhibit broken up in transit. Dr. Hickey's admirable exhibit of stereo head plates showed also a novelty in lighting, the Cooper-Hewitt light. Though not new, it has not appeared in our exhibits before. Dr. George exhibited some excellent prints of intestinal conditions. Dr. Darling had a large frame in which dental conditions occupied a prominent place. Dr. Cole (L. G.) exhibited lantern slides of 119 cases proven by operation. 34 of these showed no organic lesion of the stomach, 23 showing pylorospasm; caused in 10 cases by an appendix lesion and in 13 cases by a colonic lesion. Among the organic gastric lesions were 9 of perigastric adhesions, 14 of gallstones and gall bladder infection, 20 of ulcer of the cap, 5 of nonmalignant hourglass stomach, 6 gastric ulcers, and 24 gastric carcinomas. In all, the roentgenologic and surgical diagnoses were printed side by side. 9 cases in which these did not agree were grouped for special study.

One could not observe the interested groups about the frames without being impressed with the great value of the plate exhibit. The impression seemed to prevail that grouping by individuals rather than any attempt at scientific classification is desirable. Probably also a very brief catalog listing the plates under members' names and without descriptions, leaving that part to

the labels on the frames, will prove more practical than the rather elaborate catalog of this year.

The plate exhibit should be recognized by every member as a matter demanding his personal interest and not left too much to a single committee. The real value of future exhibits will be in proportion to the prevalence of this spirit.

D. R. B.

Bertolotti: Nosology of chronic ankylosis of the spinal column (Ueber die Nosologie der chronischen Ankylose der Wirbelsaeule), Arch. phys. Med. u. med. Technik, 1913. VII, 4.

The author gives his experiences in the roentgenologic study of ankylosis of the spinal column during the last nine years.

The general theory of the cause of this disease was that of hereditary tendency with added trauma, called heredo-traumatic cyphosis. According to Bertolotti this heredo-traumatic cyphosis, described by Marie in 1897, has nothing to do with Bechterew's disease (1893) and is neither an independent disease nor a symptom complex, but can, in the majority of cases, be traced back to a disease of the membranes of the spinal cord, or a latent fracture of the spine.

The nine cases of the author are illustrated in nineteen fine pictures and sketches and deal with two cases of spondylosis (type P. Marie-Struempell), two cases with the symptom complex Bechterew, one of them with latent fracture of the atlas and the other with cervical pachymeningitis further a case of traumatic cyphosis, as such is described by Kuemmel & Hemle, with latent fracture of the ninth dorsal vertebra; two cases of ancylosing rheumatism of the spinal column with bridgeform exostosis and osteophytosis between two lumbar segments, and finally two cases of arthritis deformans of the lumbar portion of the spine.

The characteristic findings in the two cases of spondylosis show a more or less generalized affliction consisting in disturbed nutrition of the bone system together with osteoporosis of the bodies of the vertebra and ancylosis of the small joints of the spinal column and ossification of the ligament apparatus, especially at the convexity; also the intervertebral fibro-cartilage showed a tendency to ossification, the cartilage was atrophied, though the configuration of the bones and joints was normal. In the first case the process was limited to the cervical region, in the second it was generalized. Descriptive is the system and symmetry of the ossification. Author leaves out the etiology and only points to the possible conception of osteoporosis as a secondary process, conditioned by the decomposition process in the spinal column, caused by an absolute immobilization and the malnutrition of the osseous tissue, resulting from insufficiency of the blood circulation in the spinal bodies. In no case a trauma could be proved; there was no hunchback in the family.

Of the two next cases which showed symptoms from the spinal cord, one had an old latent, badly healed fracture of the first segment of the atlas with compression of the spinal cord from callous formation; in the other case neither ancylosis of the bodies of the spine nor diseased ligaments were present and the case was considered as symphosis caused by myesthenia, probably a result of insufficiency and atrophy of the muscles, which on its part was caused by spinal hypertrophic pachymeningitis. Both patients had suffered a fall upon the neck or head 23 and 24 years ago; also here no heredity. In the case of traumatic kyphosis, as described by Kuemmel, was no heredity: the patient had had a fall 5 m. down upon the head and had shown temporarily spinal symptoms; about two months after the accident there appeared severe pain in the back and a dorsal kyphosis with a considerable hump in the height of the ninth dorsal vertebra, which improved with bed rest. The roentgenogram showed a fracture of the ninth dorsal vertebra obliquely from the right above down to the left, and after the strong dislocation probably, also a fracture of arch. Therefore, the so-called traumatic

cyphosis is a latent primary fracture of the spinal column.

The rheumatic spondylitis is a simple affection of the articular cartilage, which leads only exceptionally to ossification of cartilaginous disks. In the roentgenogram single dispersed osteophytes are seen, which are mainly laterally arranged in the hight of the intervertebral disks and are apparently formed at the expense of the intervertebral cartilage and the periosteum. Generally they connect the two vertebral bodies like a bridge. There is no atrophy of the intervertebral discs. This affliction is found mostly only in the 2-3 segment of the spinal column. Clinically it is characterized by a painful ancylosis, localized in the lumbar region in people who have gone repeatedly through acute articular rheumatism. In one of the cases was heredity of this disease but not of the hump; in the other case the osteophytosis was accidentally discovered during an examination for renal or ureteral calculi, to which the peculiar trouble of the patient was pointing; neither the patient himself nor his ascendency had suffered from rheumatic symptoms, but the roentgen findings were pointing to rheumatic spondylitis.

In the author's two cases the spondylitis deformans is characterized by vacuolar osteoporosis and a considerable deformity of the vertebral bodies, consisting in uneven thickness, deviation of the surface of the joints, atrophy of the transverse and spinous process, formation of osteophytes, irregular atrophy of the intervertebral spaces and production of a strong osseous protrusion in the hight of the ligamentous part. Clinically there was painful ankylosis of the lumbar region, muscle atrophy of the pelvic girth mainly, and symptoms of arthritis deformans also in other parts of the body.

The article is long and interesting and should be studied in the original.

Bumm, E.: Irradiation of carcinomata (Weitere Erfahrungen ueber Carcinom-bestrahlung). Berlin. klin. Wchnschr., 1914, LI, 193-198.

Bumm reports the results he had with mesothorium treatment for carcinoma of the uterus, which are very favorable so far, and then gives his experience with roentgenization of carcinoma. For the last year and a half the roentgentherapy has been applied at the Universitaets-Frauenklinik at Berlin, together with radioactive substances. Experience has caused him to employ roentgenization at a larger scale, so that at present the main treatment of carcinoma of the uterus consists in roentgenization, and for radioactive substances are only used for the local treatment of primary carcinomatous foci. The application of mesothorium and radium in an effort to affect also the deep located foci caused mostly local and general injuries. The necessity to place the radioactive substances next to the diseased parts, if any effect is to be gained, brings the superficial tissue parts necessarily into the area of the intensively burning irradiation. This is different with the roentgen tube. It gives far larger quantities of hard radiation, than even considerable quantities of radioactive substances. Where larger surfaces are to be exposed, the roentgen tube deserves without doubt the preference. An irradiation in the depth is more perfectly effected with the roentgen ray, because the tube need not be placed so near the diseased parts, so that the injurious irradiation is avoided and yet a sufficient quantity of hard rays is left to be effective in the depth.

With roentgenization alone five cases of operable carcinoma colli were treated, which are all cured; in place of the carcinomatous proliferation no pathologic changes are left, and during the treatment and afterwards no injurious effect was noticed. Of two inoperable carcinomata, one is locally healed, the other one considerably improved.

Lange, O.: Diseases of the hypophysis and its surroundings; binasal hemianopsia (Zur Kasuistik der Erkrankungen der Hypophysis und deren Umgebung, sowie zur Kenntniss der binasalen Hemianopsie). Klin. Monatsbl. f. Augenheilk. 12 illustr., 1913, XVI, 15-29.

A 58-year-old male patient, corpulent, of exceedingly happy disposition, who had red

vision, and whose pupils narrowed less with temporal than with nasal illumination, with bitemporal hemianopsia, atrophy of the opticus, became bilaterally blind after a passing oscillation. The roentgenogram showed the sella turcica considerably enlarged from back to front. Lange diagnosed cystic new formation of the hypophysis of the infundibulum.

In a 23-year-old male patient with loss of reflexes of the pupils right mydriasis, strabismus div. paralyt. of the right eye, bilateral atrophy of the opticus, almost complete binasal hemianopsia, great thirst, emaciation and headache, the roentgen examination showed an exceedingly deep and on top wide gaping sella turcica, which the author considers still normal; he explains this case as hemorrhage or softening in the fibrous dorsal layer of the chiasma.

Nothing abnormal could be found in the roentgenogram of the following case: 30-year-old woman, amenorrhea, severe headache, dry scaling skin of hands and face, hyperemia of the optic nerves, bitemporal hemianopsia, decrease of vision, who was always of a very cheerful disposition, died suddenly with spasms and tantalizing headache. Lange believe firmly that there was a tumor of the hypophysis. (Illustr.)

Warnekros: The technic of Roentgenization of carcinoma (Zur Roentgentechnik der Carcinombestrahlung). Berlin. klin. Wchnschr., 1914, LI, 198-201.

To prove the difference in the quantity of radioactive substances and roentgen rays, Kienboeck strips were placed into the vagina of a patient and then irradiated from the abdomen alternately with roentgen rays and mesothorium. With roentgenization of only ten minutes the developed strip showed a stain up to 10 X, whilst the effect of an irradiation with 200 mg. mesothorium for the same length of time was 0, and also after irradiation for over an hour with the same quantity of mesothorium; only after an application for 11 hours a stain of about 1/2 X could be perceived. Still more obvious is the difference on the manikin. A modern roentgen tube gave 100 tp. 120 X on the surface and intensive effect at a depth of 30 cm. tissue with a focus distance of 22 cm. under 3 mm. aluminum and an exposure of 10 minutes, whilst an effect of 200 mg. mesothorium 22 cm. from the surface of the manikin distant, could not be read on the uppermost Kienboeck strips after an exposure of 15 hours.

Experience at the Universitaets-Frauenklinik in Berlin has shown that a combined roentgenization from inside through the vagina and from outside through the skin is necessary to get the best results for carcinoma of the collum uteri. The character of malignancy of the carcinoma, unlike that of the myomata, requires quick influence upon the diseased part, so that a proliferation is prevented, and this can be done only with tubes which give in the time unit the greatest possible quantity of rays which cause so little injury to the skin, that an interruption on account of burning of the skin is not necessary. This result has been gained with the maximum tube Veifa. Warnekros has irradiated with these tubes, which in 10 minutes with a focus distance of 20 cm. and 3 mm. aluminum filter gave 80 tp. 120 X, the single fields 5 and 10 minutes thus applying up to 120 X to one part at one time. With that the erythema dose had been far exceeded, but the same fields were exposed the next day again for 5 minutes each so that in 20 successive days of roentgenization the outer skin of the patient, divided in 16 fields received up to 3,500 X.

The fields were chosen in such manner that especially the region of the uterus and the glands were exposed from the front, from behind, and from the sides. The fields directly above the carcinomatous focus were most intensely irradiated from front and back in the median line, so that the four fields concerned, received 350 to 370 X during the first eight days. In every case the effect upon the outer skin was very slight; eight days after the first symptoms of inflammation the redness disappeared without having caused the patient any molestation.

The superficial skin scaled off, the skin took a brown stain and showed finally the known pigmentation.

That the hard irradiation with these Veifa tubes has a greater intensive effect in the depth than with other tubes, has been proved on manikins and on the living. The experiments further showed that with roentgenisation with the Veifa maximum tube through the muscles and bones of the pelvis and the thigh after few minutes an effect of several X was obtained.

A 31-year-old patient with rapidly growing infiltrating medullar carcinoma of the portio, which had proliferated over the anterior vaginal cavity had been roentgenized at the beginning percutaneously only. After 14 days treatment the ulcer was clean, hemorrhage had stopped, and the infiltration receded, on the borders of the tumor a new formation of skin was seen, but exploratory excision showed still some living carcinomatous cells, the patient was also vaginally roentgenized and received within 10 days vaginally 1000 X. After this combined treatment the exploratory excision showed only necrosed carcinoma cells.

The apparatus employed were Veifa reform apparatus, Amrhen's maximum tube, and the induction apparatus Reiniger, Gebbert & Schall with the improved gas interruptor of Baumeister. The Veifa Amrhein's maximum tube with permanent cooling of the anticathode by compressed air and water spray permits an uninterrupted use of the same tube with 5 milliampere up to one hour without decrease of the effectiveness of the tube or heating of the anticathode.

The new apparatus has further the advantage that it allows a simultaneous irradiation with three tubes, two abdominally and one vaginally applied without discomfort to the patient and disturbing influence of the tubes upon one another.

Experiments are under way with a specially by Bumm prescribed and designed vaginal tubes made of quartz glass. After the vagina is protected by a speculum a protruberance on the tube which contains the anticathode at the end, on the mirror of which the cathode rays are intravaginally transformed into roentgenrays, is directly introduced into the vagina.

Fiorini & Zironi: Immunicorps and Roentgen Rays (Immunicorps et rayons Roentgen.) Arch. d'electricite med., 1914, XX, 113-116.

During the last year the authors have done experimental research work on the action of roentgen rays upon immunicorps.

Agglutines and roentgen rays: Cultures of typhus in bouillon were inoculated in the peritoneal cavity of rabbits at intervals of seven days, and seven days after the last inoculation the animals were bled for the research of blood serum. One group of these rabbits served for controls and the other was irradiated during the immunization with the following technic:

The rabbits were roentgenized first from the abdomen and then from the back with massive doses of about 16 X, under 1 mm. aluminum filter, with medium hard tubes (Mueller water cooling 200 mm.) with focal distance of 15-20 cm. letting the rays fall upon the base of the thorax. Some animals were roentgenized right after the first injection and some right after the third injection. The results of the research on the agglutinating power of the serum of these rabbits upon suspension in physiologic solution of cultures on agar for twenty-four hours were the same, as much for the non-irradiated as for the irradiated, the agglutinating power oscillating between 1/1250 and 1/2500.

In each group equally strong and feeble agglutinating power is found. It was noticed that the animals which were irradiated after the third inoculation of the antigenes had a more marked agglutinating power.

Substances which are apt to deviate the complement and the Roentgen ray: With the serum of these same animals the deviation of complement was examined using as antigene 1 cm. cubes of a suspension of typhus bacilli in a physiologic solution. It

was found that the inactivated blood serum of the rabbits as well as the bacilli suspension had in themselves by no means the power to deviate the suspension; the doses of serum for each rabbit in this quantitative research varied from 2/100 to 2/1000 of the centimeter cube. There was always complete deviation without difference between the animals of the different groups.

Hemolysines and the roentgen rays: For this part of the research the rabbits were inoculated with doses of 5 cm. cubes of suspension at 5 per cent of red globules of lambs carefully washed.

The first inoculation was made into the marginal vein of the ear; the two others (from seven to seventeen days), to avoid anaphylactic symptoms, into the peritoneal cavity. The doses of irradiation varied from 10 to 12 X, given in repeated sittings during the immunization.

Seven days after the last inoculation, the rabbits were bled to death and in the inactivated serum the hemolysing power with regard to globules of sheep, using for complement fresh serum of cobaye.

Experience has shown that there is no remarkable difference in the hemolytic power of the serum of irradiated and non-irradiated animals.

The rabbits which were previously inoculated with typhus cultures in bouillon were bled again after the bleeding necessary for the aforesaid researches, and then irradiated with various doses for the different animals of from 5 to 12 X, always with aluminum filter of 1 mm. and the above mentioned other modifications.

The animals were re-bled immediately after the irradiation and then again one hour later and twelve and twenty-four hours later; the serum which was thus obtained was examined for its agglutinating power and in no case was an augmentation or diminution of the content of agglutine observed.

The action of roentgen rays upon the immune bodies in vitro: For these researches fresh serum of cobayes, hemolytic amboceptors, agglutinating serum for typhus and doubtless syphilitic serum.

These serums were placed in flat glass capsules, uncovered and irradiated with doses varying from 5 to 10 X with half soft tubes, and 10 cm. anticathode distance (Drissler tube of 11 cm.).

Right after the irradiations quantitative examinations as to the complementary hemolytic and agglutinating power were made; there was a quantitative determination of the Wassermann reaction upon the syphilitic and control serums.

Even in these series of experiments it was impossible to bring a definite action of the roentgen rays into evidence; there was only a slight diminution of the complement power of the irradiated serum.

Adaptation of microorganisms to agglutines under the effect of roentgen rays: For this research typhus bacilli were used which were cultivated in bouillons additional to 1/2000 serum agglutinating for typhus at 1/2000. After twelve hours incubating some of the cultures in bouillon were irradiated with doses of six to eight X with medium soft tubes, six centimeter focus distance. The indicated doses are in fact those which are absorbed by the cultures. After the irradiation the cultures are placed in thermostats and after twelve hours they are transplanted on agar. These same cultures are then again irradiated with the above mentioned doses and placed in the thermostat at 37 C for twenty-four hours, then again transplanted and then the germs of the first and second transplantation compared with the control germs which are not irradiated for their agglutinability. Not the least difference was discovered, with the one as well as with the other the same degree of agglutination was obtained.

BOOK REVIEWS

KLINISCHE ROENTGENDIAGNOSTIK DES DICKDARMS UND IHRE PHYSIOLOGISCHEN GRUNDLAGEN. By Dr. G. Schwarz. 153 pages with 108 illustrations. Verlag von Julius Springer. Berlin, 1914.

Schwarz's description of the Roentgen-opaqued physiological colon is quite complete. Five chapters, well illustrated by charts and Roentgenograms, provide discussion of Schwarz's individual experiments and contemporary research under the following headings:

I. The Natural Caseous Content of the Colon.
II. Artificial Air-distention of the Large Intestine.
III. Mechanical Influences of the Gas-filled Colon Upon Neighboring Organs.
IV. The Colon Picture After Ingestion of Opaque Food.
V. The Movements of the Colon—(a) Passive; (b) Active.
VI. The Progress of the Colonic Contents.
VII. Variations of the Colon Picture in the Same Individual; The Influence of Fasting, Opium and Cathartics.

The major portion of the monograph consists of fourteen chapters upon the pathological colon. The chapter upon Chronic Constipation is divided simply in descriptions of hypokinetic and dyskinetic obstipation. It recites minutely the masterful studies of Stierlin. Fortunately there is not the noticeable confusion which is always possible in any lengthy description of these so-called functional obstipations.

Undoubtedly this book would be more valuable to our surgical confreres if Schwarz had chosen to enter in a discussion of the surgical importance of certain pathological Roentgen findings. It may be surmised, however, that the author has astutely avoided the criticism which surgeons, untutored in Roentgen lore, would have heaped upon him. At present there seems to be a sort of truce established between the surgeon and the roentgenologist, the former considering an exploratory abdominal section more valuable than the Roentgen survey of the opaqued viscera, while the latter believes the opposite and is willing to permit time and experience to determine the issue.

It is a pleasure to read Schwarz's frequent references to the original researches of American authors. There are many acknowledgments of his indebtedness to Case in the preparation of certain chapters and the illustrations supplied by Case and Pfahler offer satisfactory contrast.

Such acknowledgment of American contributions to gastro-intestinal roentgenology is especially flattering in view of the fact that the American impetus to such studies has usually originated from a Viennese influence. Our American literature is constantly illuminated by references to Schwarz, Holzknecht, Jonas, Kreuzfuchs, Eisler, Freund, Haudek and other native Vienna roentgenologists.

Especially commendable are the chapters upon Chronic Catarrhal Colitis, Colitis Mucosa, Ulcerative Colitis, Ileocaecel Tuberculosis and Stenotic Tuberculosis of the Colon.

The chapter upon Carcinoma of the Colon is the most exhaustive in the book. We Americans were favored with a visit from Haenisch some years ago, who is given credit for the original work upon this subject. Schwarz's additional information invests the subject with a completeness that will demand an unforeseen originality to reopen discussion.

A unique suffix is found upon the last page of Schwarz's book which we hold worthy of verbatim quotation.

"While employed with the revision of the present book a composition of Nassauer

(Munch. Med. Wochenschr. 1912, No. 51, pages 2845, 2846), 'The University for Physicians and Patients,' came into my hands. The physician, Dr. Hellmann, comes to his home in the evening weary and tired, and talks over with his wife many things that lie close to his heart. Whoever reads this discourse will not put it aside without deep emotion. The following sentences made a deep impression upon me (Schwarz). Then he said (Dr. Hellmann): 'We physicians at the bedside grow pessimistic over the progress in the establishment of correct diagnoses. Why do not the medical schools strive to give us newer and better drugs? We are concerned with the healing and health of our patients, who are indifferent to everything else. What interest have they in a beautiful diagnosis?'

"I (Schwarz) must admit that for a moment the goal which I have striven to reach in this undertaking appeared to be superfluous. The thoughts of all the unfortunates who, in spite of all improved diagnostic methods, must daily continue suffering and perish, came to me. But in the midst of such disconsolate imagination other memories came to mind, where through the application of modern methods of examination in this and that case a timely operation was performed, another was guarded against a superfluous operation. And after prolonged reflection the doleful words of Dr. Hellmann became ever more distant and hazy. Clear vision is above all the fundamental qualification of medical practice and every procedure which promotes this clear vision of the physician, who knows when and how, will benefit the sick. Today, not less than in times gone by, does the old saying hold good, which our memorable teacher, Nothnagel, has ever impressed upon us, 'Qui bene diagnoscit, bene curable.'"

E. H. SKINNER, M. D.,
Kansas City, Mo.

THE CANCER PROBLEM. By William Seaman Bainbridge. The MacMillan Co.

This book fills a long-felt need and is of value not only to those interested in the history and development of cancer research, but to the general practitioner as well. The easy style of the author, together with the lack of highly technical theories and terms makes it easy and enjoyable reading.

The work is admirably divided into fourteen sections, each of which is a review of the literature published under the subject matter to which the section is devoted. In these sections the labors and opinions of the foremost thinkers upon the cancer question are given without regard to the author's convictions. At the end of each section a summary is presented that impartially presents the value of the subject matter reviewed.

The first section is devoted to History and the others in order to: General Distribution, Statistical Considerations, Etiology, Histopathology, Cancer Research, Clinical Course, Prophylaxis, the Investigation of "Cancer Cures," Non-Surgical Treatment, Surgical Treatment, Irremovable Cancer, Institutions for the Care of Cancer Patients, and The Campaign of Education.

The work is of value not only because of the clear and concise manner in which the various subjects are handled, but also as a reference book to the large amount of literature which has been reviewed in its preparation.

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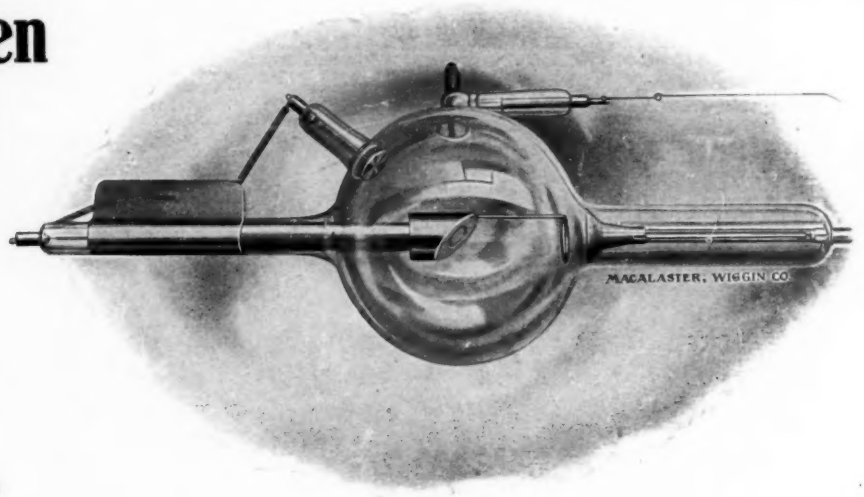

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